IMPROVED ROADS.*

BY S. A. BUCHANAN, CIVIL ENGINEER, BELLEFONTAINE, OHIO.

The subject of improved roads is one that covers a vast stretch of time and space, and in our present day occupies a place in public economy of more importance, perhaps, than at any previous time. In the olden time the perfection attained in the construction of highways was greater than now. Some of the old Roman roads, which by the accumulating dusts of ages were entirely hidden from view and had been altogether lost trace of, have recently been discovered, that stand as fitting monuments to the illustrious nation to whom they owe their existence. As to alignment, they are characteristically Roman. Varying neither to right nor left, they pass directly over or through all obstacles, and on examination of their construction, we find they are formed of huge rectangular blocks of stone dressed to a smooth surface on top, placed at a uniform height in cross section and fitted together with the greatest care and precision, and, as if to farther increase their strength, these huge masses of stone are again bound together by strong iron bars, the ends of which are firmly imbedded in the contiguous faces of the stones. With the decay and fall of the great empire, the sound of traffic and din of hoofs died away, and these grand old thoroughfares passed into oblivion, and the construction of indestructible roads became one of the lost arts.

In the early history of our own country, the constant struggle for existence consumed all the energies and resources of the pioneer settlers, and all thought of luxury in traveling, or even conveniences, except the most meagre, was totally excluded. The narrow, tortuous trails of the aborigines served in a great measure the purposes of necessary travel, while the wagon roads were but little better than mere openings cut through the woods, and at that time it required a very skillful driver to miss the stumps and avoid the chuck-holes. With the advent of stage coaches, some little attempt was made at improvement on the more important roads. The chuck-holes were filled up, and in marshy places the road was supported by corduroy, which consisted of logs laid close together and across the road. While this corduroy was an improvement in some respects, at least inasmuch as it relieved the passengers from the necessity of getting out and prying the coach up out of the mud, as had been frequently the case previously, it was nevertheless a very rough road to travel, as shown by the experience of an old lady, who made a journey for the first time by stage coach. After passing a few miles of almost impassable road, they came upon the corduroy, over which the coach bumped and bounced like all possessed, and the passengers were all rattled about like peas in a gourd, when, turning suddenly round the brow of a hill, the coach upset, and, making a complete revolution, brought up standing against a tree. The first to regain her seat was our old lady friend, who thought that was a part of the regular programme, and putting her head out of the window called to the driver, "*I say, mister, if this pesky thing is going to* CONTINUE *to ride so powerful onsteady, I believe I will get out and walk a while.*"

The free turnpike, or graveled road improvement law came into existence about 1863, and under the provisions of that law about 4,000 miles of road have been built. A request for full statement of mileage, cost of construction, repairs, etc., was sent to the various county auditors throughout the State, but as quite a number failed to respond, the totals and general averages for the State can only be given approximately. More than one-half the counties in the State are as yet without free pikes, and in many counties there are no improved roads of any kind. As to mileage, Warren County takes the lead, her present number being 624 miles, then follows Miami with 500, Shelby 326, Montgomery 300, Logan 285, Madison 265, Hardin 250, and so on down the scale to Jefferson County, which foots the list with 4 miles. The average cost per mile for construction runs as follows, Hamilton County being the highest at $6,228 per mile; next Scioto County, $3,448; then Sandusky, $3,000; Shelby, $2,772; Hardin, $2,400, and the lowest is Paulding County, $800. The cost of repairs could not be obtained in counties where the work was done under the supervision of the township trustees, but in the remaining counties the average cost per mile of repairs, for the last year has been the highest in Scioto County, being $104; Miami, $70; Sandusky, $57; Hardin, $44; Shelby, $30; Auglaize, $23; and and the lowest in Madison County at $15 per mile. The average cost per mile of construction for the State is about $1,800, making a total cost of construction $7,200,000, while the average cost per mile of repairs for the last year is about $27½, which represents an annual expense for repairs amounting to $109,000.

We will now examine hastily a few points in the construction of improved roads, and then offer some suggestions as to the best means of keeping them in repair. The methods and dimensions herein given for construction are not infallible; but, nevertheless, have each been arrived at, and found quite satisfactory after a series of experiments extending over a period of several years' practice and close observation, in which the writer has endeavored with each succeeding year to improve, as far as possible, upon the form of construction used the year preceding. One of the essential points, and one which the engineer should look well after at the time of locating, is to provide ample width for the construction of the road. The avariciousness of adjacent land owners and the timidity of the average board of road viewers will often be found to act as powerful astringents on the width of roadway, and the engineer should always be prepared to take a decided stand on that point and give himself plenty of room. The roadway should never be less than 50 ft., and in certain places, as in hilly country, the cuts and fills are large, or in wet swamp lands, where deep side ditches are needed, even this width must be increased variously up to 100 ft. The construction of summer tracks for turnpikes will not be discussed in this paper, as it is a point of considerable importance and would require more space than could be devoted to it here, and we will therefore confine our remarks to roads without summer tracks. The width of road-bed on top should be varied according to the amount of travel which the road will probably have to sustain; thus, for a by-road, where the travel is very light, a road-bed 20 feet wide on top may be sufficient, while for a main thoroughfare the width should not be less than 30 feet. The top of the road-bed should be made slightly rounding, from side to side, the amount of crown to be from 6 to 10 inches, depending on the width of road-bed, the greater crown to be given to the greater width; except, where the bottom of side ditches, on either side, are 3 feet or more below the level of the road, in which case the top of the road bed should be made level from side to side. The proper construction of the side ditches, is a matter of prime importance, and the extremes, of either too much or too little side ditch, are both very bad. In the first roads that were built the side-ditches were made too close to the road. entirely too small, and generally without view to the purpose of drainage, for, on the dry ground they would be very crooked affairs winding in and out, around stumps, stones, etc., and in the low ground where earth was needed for filling, there were merely a succession of borrow-pits, of various depths, in which water stood the year around. unsightly ponds, disagreeable to the eye and injurious to the road. Perfect drainage is an absolute necessity in the construction of a durable road, and the engineer should so construct the ditches as to draw the rain-water quickly and entirely away from the centre of the road, and should also provide good and sufficient outlets, as a side-ditch left standing full of water is as bad or worse for the road than no ditch at all. The bottoms of the side-ditch should always be kept as far as practicable from the centre of the road, should be cut smooth and straight, parallel with center line, and in ordinary grading at a distance of about 10 ft. from the edge of road-bed, and the grade should be so constructed as to have a regular straight slope from the edge of road-bed down to the bottom of the ditch. In summit cuttings of 2 ft. or more in depth, the bottoms of the ditches at the summit may be made within 2 ft. of the edge of the road-bed, but should be made, on each side of the summit, to diverge from the center line of road, so as to regain their usual distance from the center on reaching the end of the cutting. By placing the side-ditches close to the road-bed at the summit, a greater depth of cutting can be obtained for the same amount of excavation, and by increasing the depth of cutting a less height is necessary in the fill, and the cost of construction is thereby greatly reduced. A level cutting is very objectionable on account of bad drainage, and to remedy this defect all cuttings should be given a pitch or grade of at least 1 ft. per 100 ft. Fills should be built in layers, of uniform thickness of about one foot, commencing the fill full width on the bottom, which bottom should be made wide enough to give the fill a slope on each side when completed not steeper than 2 ft. horizontal for each foot vertical. Various expedients have been resorted to by engineers to counteract the settling in fills. None have proved entirely satisfactory. A very simple plan, which gives fair results in fills of three feet or more in height, is to have the fill built in the regular way up to the height required for grade line, and then allow it to stand five days for each foot in height of fill at deepest point, after which the work can be again built up to grade line and completed as desired. If the time set for completion of contract will not allow time for settling of fills as above, then about 20 per cent. should be added to the required height of fill, and the work may be completed at once. The general form of the road must be made with reference to the country in which it is located; thus, a road on flat, prairie or wet lands must be made with special reference to drainage, providing ample and well-constructed side-ditches, from 18 in. to 3 ft. deep, and the grade line should be carried well up, so that the roadbed shall always be high and dry; whereas, in rough, hilly country, the operation is in a manner reversed; provision must be made to prevent side-ditches from washing too deep, while the grade line should be placed as low as possible, and avoid as far as practicable the building of very high fills; the latter for two reasons: 1st, as a matter of economy in construction and subsequent repair; 2d, as a precaution against accidents in icy weather. A road, very good in other respects, may still be made quite unsatisfactory by having a very high grade line and deep side-ditches, which render it inaccessible to adjacent lands; hence the necessity for keeping the grade line as low as possible, and to avoid making ditches deeper than the proper drainage of the road requires.

In the matter of repairs and maintenance of free turnpikes and improved roads, there is room for vast improvement over the ways and means now employed. There are three different plans or systems by which the work of repairing is done. First, by county commissioners; second, by township trustees; third, by pike superintendents. In about four out of every five counties the work is done under the supervision of county commissioners. A few counties still have the township trustee plan, and only two counties, so far as heard from, employ pike superintendents. While there are three styles of management, there is but very little difference in the manner in which the work is done, nor can there be any great deviation from the line of action pursued in the past, nor very much improvement made in the future until by requisite legislation the whole system of pike repairs shall be thoroughly renovated and set up anew. The method in general use has been each spring and fall to select such portions of the road as appear to be in the worst condition, and after an estimate has been made of the number of cubic yards of material necessary per rod for repairs the work is sold out by the yard to the lowest bidder. The specifications for the work are generally very indefinite, and often they consist of a mere oral statement made at time of sale as to about how it is expected the work will be done, while the price per cubic yard, marked down somewhere as a memorandum, comprises the sum total of bond and contract required of the party to whom the work is awarded; and the very natural result in such cases is that when a contractor with an elastic conscience takes a job at a very small margin he slights his work both in quantity and quality of materials used—especially so when good materials are scarce and have to be hauled a long distance; and this he can do with impunity if there be a want of proper specifications of the quality of materials to be used and of the manner of doing work, and also, of a good and sufficient bond, conditioned upon the faithful performance of an explicit contract.

Under the management of the township trustees the most inferior work and unsatisfactory results have, as a general thing, been obtained. This is by no means a proof that they are the most incompetent officers. On the contrary, a man may be well fitted for the office of township trustee and still be an entire failure as a manager of road repairs.

The office of pike superintendent is filled by a person elected in each township specially for that office, who has full control of the repairs of all the pikes in his township. He makes all the contracts for labor and materials, and personally oversees the work of repairing the road surface; and in addition makes all repairs on bridges and culverts, when the cost of such repairs falls within the limit of the amount fixed by law. The work done by superintendents represents all grades, from the very best to the very worst; depending solely upon the ability and qualifications of the superintendent himself. When he is good he is very good, and when he is bad he is horrid.

As we consider the work done by county commissioners, we find there are several serious objections to it, most of which in a greater or less degree hold good as to the work of trustees and superintendents. The lack of proper attention, and the want of good judgment, in the maintenance and preservation of bridges and culverts is a fact of which the most casual observer cannot be ignorant. Within the last few years, great improvement has been made in the quality of work in bridges, both in the substructure and superstructure. The cheap rubble work formerly used in abutments, and which lasted on an average about ten years, has given place to first-class range rock work, which will stand the wear of ages; and the light and frivolous modern superstructures, at one time so very abundant through the length and breadth of the land, are now about all gone where the woodbine twineth, and as fast as possible their places are being supplied with solid wrought-iron bridges, having the capacity from four to six times the strain of the heaviest load that can come upon them.

Now, it is undoubtedly true that the construction of the finest and best bridges requires the finest and best skill, and it is also true that their proper

* From the Third Annual Report of the Ohio Society of Surveyors and Civil Engineers.

preservation requires that they should be under the care of a person thoroughly conversant with all parts of the structure, and who fully understands all the principles involved in their construction. The repair of culverts occupies a less important place than the repair of large bridges, but the safety and welfare of the traveling public requires that they too should be promptly and well looked after. A floor plank or other part of a culvert often gives way, so as to make it dangerous for horses or vehicles to pass over, and before it can be fixed word must be sent perhaps ten or fifteen miles to one of the county commissioners, who must make a special trip to discover the extent of the damage, and give out a contract to have it repaired, and from five days to two or three weeks may and does often pass before the culvert is made whole again, during which time the public is exposed to danger of accidents more or less serious; whereas, if the work had been under the inspection of some convenient person, the breakage might have been entirely prevented, or at any rate repaired a few hours after it occurred.

This much as to bridges and culverts.

Now as to road surface. We find that the same piece of road is repaired only once a year, and after the work has been done very little or no attention is paid to it until the next season of annual repairs, and thus during the winter and wet season of the year, when the surface of the road requires almost constant attention, it is entirely neglected, and for the lack of the "stitch in time which saves nine," it changes rapidly from bad to worse, and before the season is half over the road is often ruinously cut up into deep ruts and chuck-holes, and public travel is seriously inconvenienced and retarded thereby perhaps for six months out of the year, during which time anything like reasonable speed is attained only by great sacrifice of horseflesh, and also at the imminent peril of life and limb when the driving has to be done after night. It is unnecessary to detail further defects which exist in the present management of pike repairs, the inferior quality and unsuitableness of materials used, the neglect and want of proper drainage from road surface and side-ditches, and other minor points, are all self-evident indications that a fault exists somewhere in the management. Certainly no good reason can be given why our turnpikes and improved roads should not be kept in good order the year round, and that too, for but very little if any greater cost than at present.

It is well known that the highways of England are far superior to those of our country, and that at all seasons of the year the English roads present a smooth, hard surface, quite suited to heavy loads or light driving. This happy state of affairs was not arrived at all at once, for if we may judge from the reports submitted to the "Committee on Turnpike Roads and Highways," in 1819, their roads then were just the counterpart of what ours are at the present time, badly managed, kept in bad condition, and, along with all, very expensive. "This state of affairs," says a competent English writer, "arose from the general defects of management, and from the ignorance of those intrusted with the repairs of the road, who were usually old servants, farmers, or broken down tradesmen." Thus we see the prime cause of failure in England was traceable direct to the fact that the management was entirely left to classes of men who had but very little or no practical knowledge of the work to which they were appointed. About this time the rival efforts of Telford and Macadam, whose names are as familiar as household words, made the construction and maintenance of turnpike roads a prominent feature in public affairs, and, with the assistance of necessary legislation, they succeeded in establishing a regular system of management, by which the turnpikes were placed wholly in charge of properly qualified road surveyors, and this same system of management, having undergone some slight modifications, is still in force in England to-day, having given the best results as to condition of roads and cost of repairs. The same writer above quoted, in speaking of ordinary highways (the same in the country being frequently called mud-roads), and of the work done by the surveyors of highways which corresponds to our district road supervisor, says: "On the ordinary highways, improvement was hindered by the system of statute duty," (poll-tax) "and by parish management under a person chosen yearly to serve the office of surveyor of highways. The parish surveyor generally had no special knowledge of road repairing, and the team labor and other work were seldom well applied. Statute duty was established, and highway rates were substituted by the General Highway Act of 1835, which also permitted the appointment of a paid surveyor, either for a single parish or highway district. Thus we see that we are only repeating the experience of England in years past, and, since she has arrived at such a satisfactory result in solving the difficult problem of road repairs, we may, no doubt, profit from her example by modifying her systems to suit the requirements of our case. Our legislators did a very wise thing, as has been fully demonstrated by experience, in placing the construction of improved roads under the control of a competent surveyor or engineer; and as the same skill which is required in the construction of any work is also requisite to its proper maintenance, so they should again avail themselves of the engineer's service by making him supervisor-at-large for the repairs and maintenance of all improved roads and bridges in the country,

We will not here attempt to give a detailed statement of the statutory provisions necessary to establish a perfect system of management, and meet all the requirements of official proceedings, in the repairs and maintenance of roads and bridges, but will only give the outlines of some of the more prominent features of a plan which, although it may not be the best that inventive skill could devise, has nevertheless several points of merit, as being calculated to reform some of the more glaring defects of the present management. The first step to be taken is to organize a thoroughly competent management, and to this end the County Commissioners and County Surveyor in each county should be constituted a Board of County Supervisors, who should have charge of the repairs of all improved roads and bridges in the county. The county area should be divided into three districts, as nearly equal as possible, one of which should be assigned to each member of the Board of County Commissioners, who should have special supervision of all the work in the district assigned to him, and whose special duty it should be to see that all contracts coming under his care are well and faithfully performed, and who should also make a report to the board at the end of each quarter, showing the condition of all roads and bridges in his district, together with all other matters which he may deem necessary to take under advisement.

The preparing of all necessary maps, plans and specifications for all work pertaining to road repairs, including the construction and repair of bridges and culverts, and also the measurement of all quantities connected therewith, should be made the special duty of the surveyor, who should also formulate all contracts for labor or materials, and also be authorized to act as clerk of the board, and to keep all books, papers and book accounts belonging to the board, and issue all certificates or estimates in payment of labor and materials, provided, however, that all plans and specifications for the construction or repair of any work, and all contracts for labor or materials, and also all certificates or estimates issued in payment of same, should be without effect and void until indorsed by at least two of the County Commissioners. The surveyor should also keep a schedule of all the bridges and culverts in the county, showing the dimensions, date of construction, and name of builder, with an itemized bill of costs for substructure and superstructure; further all plans and drawings, or a convenient sized copy thereof, and also a copy of the specifications, for each bridge and culvert in the county, costing, say, more than $200, should also be kept by the surveyor in convenient book form for reference in future repairs. This will be especially valuable in repairs of river piers and large abutments in cases where the bottom of the stream either changes location or depth to any great extent, for by reference to the plans the exact depth of the masonry with reference to the stream can be seen at a glance, and the safety or peril of the structure immediately decided. The same thing, though in a less degree, may be said of all our other bridges and culverts. The board should be authorized to act as bridge inspectors for the county, with power to procure the services of an expert bridge engineer, in case they should deem it necessary. The board should be required, at least once a year, to make a thorough and careful inspection of each large or important bridge in the county, noting in detail the condition of the various parts, and a formulated report showing the results of such yearly inspections should be made out and kept in the surveyor's office as part of the bridge record. The surveyor should also furnish suitable maps of all the improved roads in the county for the use of the board, and said roads should be divided into convenient sections for the purpose of awarding contracts for repairs. The board should have the privilege of doing the work of repairing either by contract or by day's labor, as in their judgment seemed best; but in whichever way the work is done it should be required that the road surface should never be permitted to cut into ruts or chuck-holes, but should be kept clean, smooth, and in all other ways in good order for public travel at all seasons of the year. This could best be accomplished by having trustworthy employés go regularly over the portions of road allotted to them, and keep up the repairs of all parts of the road-surface, side-ditches, etc.; they should also be instructed to keep watch upon the bridges and culverts within their bounds, and to immediately repair all small breakages, as in floor planks, joists, etc.

The amount of road allotted to each contractor or day laborer should be such as to employ his entire time, thus allowing him to devote his entire attention to his work upon the road. If the work be done by contract, it should be made to cover a period of from three to five years, and be terminable at any time, upon order of the board, provided, in their judgment, the contractor does not comply with the requirements of the specifications. Payments for labor and materials should be made at stated times, either monthly or quarterly, by estimates issued by the surveyor, which estimates should be issued upon certificate of the commissioner in charge that the work has been done to his satisfaction, or upon personal inspection of the work by the surveyor himself. The main objects to be accomplished are: *First*, That the roads and bridges should be placed under the constant surveillance and watchful care of trustworthy employés, who would devote their whole time and attention to the work, and whose duty it should be to keep the work in first-class order at all times and in all seasons of the year. *Second*, The formation of an effective and thoroughly competent management in each county, with better judgment and greater facilities for overseeing the work than heretofore. *Third*, The organization of a thorough system of bridge inspection through which the entire order of bridge work will be greatly improved—in the first place by preventing the construction of inferior bridges, bad in plans and worse in execution, as is frequently the case in highway bridges; in the second place, by having the bridge repairs under the management of a board, who, if not at first, will in time, become thoroughly skilled in the work, and be able to grapple successfully with every question which may arise; and in the third place, by reason of the vigilance of the road employés, and, as a result of annual inspection, the wants and requirements of each bridge will at all times be well known to the board, and all repairs can therefore be more thoroughly and scientifically made than heretofore. *Fourth*, By placing the work under the influence of a competent surveyor or engineer, it will receive the full benefit of his knowledge and experience, which will be exhibited in many ways, such as an improved order of specifications, better and more suitable quality of materials used, more explicit and binding contracts, and a general improvement in manner of doing work.

In several counties the sum invested in improved roads alone amounts to more than half a million dollars, while in Shelby county it reaches the handsome figure, $903,847. The people are gradually awakening to the fact that they have a vast amount of money expended in improved roads, and those that are in the advance plainly foresee the necessity for great improvement in the maintenance of these roads, in order that they may be a profitable investment to the public. May we not then hopefully look forward to the day when all the roads and highways of Ohio, by the able efforts of competent surveyors or engineers, shall be made as far superior to what they now are as the best turnpikes or improved road of the present day are superior to the ancient corduroy?

CHOLERA AND WATER SUPPLY.

In an article entitled "Cholera and our Water Supply," in the current number of the *Nineteenth Century*, Dr. Percy F. Frankland draws attention to the vital connection between water-supply and the diffusion of zymotic disease. He points out how, in consequence of the terrible epidemics of Asiatic Cholera to which the metropolis has been subjected to in the past, the companies supplying London with water from the Thames have been obliged to remove their intakes to a distance, which shall insure the freedom of their supply from contamination with the London sewage, and thus, at any rate, to put an end to their former practice of "rapidly restoring to the inhabitants of London the drainage matter which the sewers had discharged." But although the Thames at Hampton is free from this sort of pollution, yet it is similarly fouled, although in a less degree, with the sewage of a population estimated at upward of half a million, which enters the river above the intakes of the water companies. In extenuation of this obviously revolting state of things, many theories have been started; of these the most popular and fallacious is that which, under the title of "the self-purification of river-waters," announces that noxious organic matter present in river water are rapidly destroyed in the course of a few miles' flow. This doctrine, unsupported as it is by any facts or accurate observations, is wholly dogmatic, and in complete opposition to all previous knowledge concerning the properties of organic matter in general. The late Rivers' Pollution Commissioners', moreover, conclusively proved that water once polluted with sewage is only very slowly purified, and more recent research further shows the great tenacity of life possessed by the lower organisms which are believed to be allied to those capable of communicating zymotic disease. Chemi-

cal analysis further proves that the Thames water reaches the intakes of the London water companies with a but slightly diminished proportion of organic matter. In the face of the now well-known fact that London possesses within easy reach water of the purest quality, and abundant in quantity, it is inexcusable that such manifestly impure sources should still be resorted to. Hitherto only one of the eight metropolitan water companies has entirely abolished the polluted rivers and substituted them by the pure water obtained from deep wells sunk into the chalk. London should follow the example of other large towns in Great Britain; Glasgow now drinks the waters of Loch Katrine; Manchester is bringing a supply from Cumberland; while London, with water of the best quality much nearer at hand, is still compelled to drink the waters of the Thames and Lea.

BOILER EXPLOSIONS.

The reports of the M. S. U. A. year after year have shown that, for one explosion due to the fault of the boiler minder, six have been due to the boiler owner or to the boiler maker. The cause of nearly every explosion is the weakness of the boiler. It is the master's fault that a cheap boiler is laid down in the first instance, and set to work at a higher pressure than it is fit to carry, or that it is worked on and wasted away till it becomes as thin as an old sixpence. Thus it is the boiler that needs examination, rather than the stoker.

A good boiler, well equipped, is a simple machine to manage, and only calls for ordinary care. It is far more important that a fireman should be careful and attentive than that he should be capable of passing a technical examination. Many firemen appear to know too much already. They know how to tamper with a safety valve in a most ingenious manner. They can take off a stop ferrule which has been put on to prevent overloading, file it down so that the safety valve may be locked fast, put on the ferrule again so as to escape detection, then get up steam and drive away until the boiler bursts. Such was the case at Maidstone, where a traction engine boiler burst on Friday, December 3, 1880, from the cause just explained, killing one man and injuring two others. Even railway locomotive drivers, who are superior to the class of men engaged in minding agricultural engines, will gag the safety valves. Passing a technical examination would not prevent this.—*Manchester Steam Users' Report.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 423.)

DLXIII.—IOWA CITY, IA.

Iowa City, Iowa, in lat. 41° 40′ 35″ N., long. 91° 15′ W., is on irregular ground on the Iowa River, the highest point being 105 ft. above the river. Settled in 1839, it was incorporated a city in 1853. Water-works were built in 1883 by the Holly Manufacturing Co. for a private company taking the supply from the Iowa River. The water is passed through 3 ft. of stone gravel sand and charcoal in a brick chamber 75 by 14 ft. and 12 ft. deep, and is pumped directly into the mains by a Holly quadruplex steam pump with water cylinders of 7 in. bore and 22 in. stroke. There is also a duplex Holly pump of 9 in. bore of 22 in. stroke. The ordinary pressure maintained is 65 pounds, and fire pressure 140 to 175 pounds.

Distribution is 5½ miles of cast-iron pipe of 20 to 4 in. diameter with 70 fire hydrants, 30 gates and 110 taps. The city pays $60 for each fire hydrant. For each one in excess of 70 the price will be $50. Service pipes are of wrought iron. The population in 1880 was 7,123. The daily consumption is 150,000 gallons.

The capital stock of the company is $120,000. The works have cost $85,000. The bonded debt is $70,000 at 6 per cent. interest.

G. B. Dinnison is superintendent of the company, and Ira A. Holly the superintendent.

OUR RAILROAD BUILDING.

The Canadian Pacific is invading the trackless wilds of the Hudson Bay Company. Who can foretell the future extent of railroading in the British possessions of North America? And then the Winnipeg idea of a road from Manitoba to Hudson Bay connecting with a line of British steamers on that frozen inland sea. The thing is impossible, certainly; but the impossible is what spoils our logic by frequently happening.

Perhaps the most Utopian of recent railway projects is Mr. H. R. Helper's "Three Americas Railway," which is to connect the United States with the various countries of Central and South America. And yet practical railroad men pronounce it entirely feasible. Already three or four lines of road are constructing to connect the City of Mexico with the railway system of the United States. The Mexican Southern is being pushed southward from the City of Mexico toward the Central American States. From the Mexican border southward the proposed road would have to traverse a little section of rough country three or four thousand miles long, but there is nothing in the Andes country to baffle modern railroad engineering. The road would wind its way through the little republics of Central America, now in sight of the Atlantic and now of the Pacific, and on down along the Andes chain, throwing off a branch to Brazil, and making a forked terminus in the Argentine Confederation and Chili.—*Minneapolis Tribune.*

CROSSING THE KINZUA VIADUCT WITH HORSE, CARRIAGE AND FAMILY.

According to a Bradford, Pa., correspondent, Wm. Batterson, of Buffalo, with his wife and two children were the participants in a most extraordinary adventure at the Kinzua Viaduct, a few nights ago.

The party left Bradford in the evening to drive to an isolated settlement named Howard Hill, the road leading through the deep forests, high among the mountains. After leaving the village of Alton, the way became especially wild and intricate, and a short time thereafter Mr. Batterson found that he had lost the road in the darkness—his horse was picking an aimless course through the woods. Upon prospecting with an old railroad lantern, found in the carriage, a railroad track was discovered a few hundred yards distant—the track of the Erie's Bradford branch. Feeling that neither his wife or children could stand a night's exposure in the mountain, he determined, notwithstanding the great danger, to drive along the railroad, hoping to find a station and a road by so doing.

He walked ahead with the lantern and his wife drove. After progressing in this way for about a mile, they came to a bridge, on one side of which was a narrow plank-walk; this was the Kinzua Viaduct, 303 ft. high, but the length and height were unknown quantities to Mr. Batterson, and he made up his mind to pass his team and family over it, in fact he could not in any other way get off the embankment he was on; it was madness to remain where he was, and to abandon the horse and carriage there was to endanger any coming train.

He succeeded in leading his horse upon the footway, the wheels on one side jumping over the crossties, his wife and children followed behind. They had proceeded on their way but a short distance when the high wind blew out their light, and they were compelled to grope the remainder of their distance in darkness. They crossed the bridge in safety, unaware of their great peril, and passing through a deep rock cut at the further end, reached Palen's Switch, just in time to escape a coal train that was actually due when they were on the Viaduct, but had been detained a mile beyond a "hot-box." A delay of one minute in passing through the cut would have been fatal to the entire party.

THE TREMONT METER.

The report of the Water Board explains the circumstances which led to the adoption or, as the board prefers to regard it, the extension of the water-meter system, but what it has to say with regard to the selection of the Tremont meter is far from satisfactory. The board is "informed" that the Tremont is "the oldest patented meter;" but the facts are, as we have shown them from the official records, that the Tremont Meter Company was incorporated under the laws of Maine only three months prior to its good luck in obtaining the approval of Mr. Cutts and the Water Board. The invention was, however, patented years ago, as was recounted in the history which we gave of its origin. The question is not as to the antiquity or the novelty of the patent; it would make little difference whether it were very old or very new, if it were the best. Nor does it matter particularly that the company which owns the patent is of such recent origin, only we thought it an interesting illustration of the principle that some concerns, as it were, are born lucky, others achieve good luck, and others have good luck thrust upon them.

The position which the board takes regarding its duty in the matter we cannot but regard as somewhat extraordinary. The report says: "The board well understood that it was instructed to purchase recording meters to the extent of $50,000, and *that it was not required to make tests or experiments.* The members of the board, however, were unanimously of the opinion that, before acting upon a matter involving so large an outlay, and practically the indorsement and approval of the measurement system, they ought to become fully satisfied that the measures adopted by them would subserve the best interests of the city." So it would seem that it was not as a matter of obligation, but as a gracious condescension and concession that the board subjected the various meters in the market to a test to determine which was the best. They might have bought $50,000 worth of the first meter that came to hand, but in order to "subserve the best interests of the city" they instructed Mr. Cutts to make some kind of a test.

This indicates an accommodating spirit, but we beg leave to suggest that it also indicates a total failure to appreciate the responsibility actually devolving upon the board. Whether it is to be described as an adoption or extension of the meter system the fact is that the action which the Board was taking involved, as its own report states, the indorsement and approval of the measurement system. It is, therefore, of the utmost importance that the meter be adopted as the official gauge of the system, and to be carried with the system as the system should be extended, should be the best, the most enduring and the most accurate obtainable. It is a matter of thousands of dollars to the citizens and to the city for years to come that this should be so. If the board was not directed to make tests, it was because it was assumed that some things could be taken for granted, and that among them was the probability that the Water Board would not buy $50,000 worth of meters as it would buy lead pipe.

We have endeavored to make it clear in what we have previously written upon this subject, that we do not assail the Tremont meter or deny that its merits may be all that Mr. Cutts and the Water Board suppose them to be. But we do insist that the possession of these transcendent merits by the meter adopted has not been established by any tests of which the public has knowledge; and further, that so important a transaction as this ought to be free from any suspicion of undue haste, of improper motive, of speculative purpose or of official favoritism. The public mind will not be satisfied upon this meter question until the meter has been subjected to a thorough and searching public test. We happen to know that this very meter was offered to the previous Water Board some time ago, and that the proprietor was told to submit the meter to a two years' test and then return with it. It illustrates the difference between Water Boards, that while one requires a two years' test, the other is content with two weeks. And that the present Water Board does not believe in losing any time in carrying out its policy may be inferred from the fact that it has already ordered Tremont meters to the amount of $34,155.50. A little less haste and a little more publicity and thoroughness would better "subserve the interests of the city."—*Boston Journal, 13th.*

The call for a new trial of water meters in the city of Boston seems to be seasonable. We believe in the meter system, and have no doubt that the general introduction of meters will reduce the consumption of water by 50 per cent. We were early in the field in favoring this system, and we consider it highly important that the best possible meter be secured. The Tremont water meter may be the best, but the fact should be established by indisputable evidence. We think well of the suggestion that the question should be submitted to the Institute of Technology for an exhaustive investigation, letting each meter have one representative present. Such an investigation would give an authoritative result. If Mr. Cutts is right, the Tremont meter would be established at the best without any question. The Water Commissioners cannot usually object to so fair a proposition, acquiescence in which would settle all doubts and leave no excuse for complaints.—*Boston Herald, Sept.* 12.

AMERICAN SOCIETY OF CIVIL ENGINEERS

SEPT. 5, 1883

A paper by James L. Randolph, member of the Society, and Chief Engineer Baltimore & Ohio Railroad, upon "Vibration or the Effect of Passing Trains on Iron Bridges, Masonry, and other Structures," was read. Mr. Randolph refers to the fact that double-track bridges are moved in the direction of passing trains and are consequently twisted, and strains are produced not provided for. Also that cattle-stops and open culverts, where built of rubble-work, have the walls shaken to pieces by vibration. The remedy he has supplied for these culverts and stops has been to build them of large stone as nearly the same size as possible. The tall, thin bridge piers and abutments on which iron bridges rest, have their stone so much disarranged by vibration as to make it necessary to secure them with timber and iron straps. Iron bridges resting on stone pedestals vibrate in this manner and receive a return blow from the vibration of the pedestal, particularly if the pedestal is on a light structure, but as the iron and the stone do not vibrate in the same period, there must be times when the result is a movement in the direction of the force. The effect of this vibration has been particularly noticeable at the Harper's Ferry bridge, where there was a movement of four inches in four years. After the insertion of planks between the stone and iron, this movement ceased. Where the masonry of piers has a platform of timber between its foundation and solid rock, no displacement of stone has

been noticed. Mr. Randolph contends that a monolith would be the best support for structures subject to vibration caused by strains, but that a monolith of the specific gravity of granite would give a damaging return blow. Timber would answer the purpose, but is perishable. The material which, in his opinion, is most serviceable is an artificial stone which is about two-thirds the weight of granite, is compact, durable, and with very little elasticity.

The paper was discussed by Messrs. Theodore Cooper, Chas. E. Emery, H. D. Blunden and Wm. H. Paine.

THE EDISON COMPANY, represented in Scotland by Mr. C. T. Grant, of Glasgow, has obtained the contract for lighting three fine steamers of the New Zealand Shipping Company's fleet. The first of these vessels, the Tongariro, has just been launched from Messrs. John Elder & Co.'s yard. The latest addition to the Clan line has also been fitted with electric lighting plant by the same company, the new means of illumination being employed for side and cargo lights, as well as in the cabins.

A NEW ENGINE.—The *Springfield Republican* says: "The few people who were in the depot just before 3 o'clock yesterday afternoon were considerably surprised to see the 2:48 train from Hartford come round the curve drawn by an engine which gave out neither smoke nor soot. It was labeled "C. Holland, No. 1," and on the tenders were the letters "N. Y. H., L. & P. Co.," which mean New York Heat, Light and Power Company, who control the patent, the inventor, Dr. Charles Holland of New York, who rode on the engine, being the largest stockholder. This locomotive uses no coal or wood whatever, merely burning the gas which it condenses from the 2,500 gallons of water which the tender holds, using 548 gas jets. It is the only one of the kind ever built, and was constructed about a year ago at the Grant locomotive works at Paterson, N. J., has a handsome exterior, and weighs 34 tons, being of the same grade as the Southern road's fast passenger engines. It differs from them merely in the construction of the fire-pot and boiler. There are four retorts in the fire-box, two for oil and two for water. When the engine is first started the gas is made from the cold water in the retort, but when the gauge registers from 20 to 30 pounds of steam the water is shut off, and the steam is taken from the boiler, which process saves heating the water twice. Even should the fire go out the engine will continue to run for some time. This locomotive has been used on the Erie road about a year for an average of four days in the week. It is claimed that the use of this patent makes a saving of $600 in repairs on the locomotive and a large one on the cars, besides doing away with the possibility of setting fires alongside the track. The improved grate can be put into an ordinary locomotive at the cost of a few hundred dollars.

THE MANUFACTURE OF CEMENT IN ULSTER CO., N. Y.

The illustrations in this week's number of ENGINEERING NEWS and the accompanying description are the results of a short tour of inspection in the valley of the Rondout Creek, among the celebrated Rosendale Cement manufactories.

According to Prof. H. D. Rogers, the natural cement rock of Ulster Co., N. Y., belongs to the Lower Helderberg group, classed as Formation VI., in the arragement of Pennsylvania Rocks. This rock is an argillo-magnesian limestone, known as the Tentaculate or Water Limestone; and from this formation, which extends along the Appalachian range, from Vermont to Virginia, perhaps three-fourths of the hydraulic cement produced in the United States is manufactured. In Ulster Co., N. Y., the cement rock overlies the Onondaga salt group in regular succession, seventeen distinct strata having so far been traced, which vary however very much in their hydraulic energy. The beds skirt the Northwest base of the Shawangunk Mountain in the Valley of the Rondout Creek, and occupy every conceivable inclination to the horizon, as will be seen from the cross-sections of the two mines shown at Binnewater, where, though scarcely a fourth of a mile apart, the strata pitch in exactly opposite directions. Some of these beds are vertical, but they are very seldom level, the general dip being northwest or southeast. The entire region bears evidence of having been subjected at some remote period to a succession of remarkable upheavals, and in some cases this action took place while the limestone was yet in a plastic state, as is proven by the eccentric twists and folds into which the stratified rocks have in several localities arranged themselves.

We might mention here that the Rosendale cements, so long and favorably known among consumers in the United States, derive their name from Rosendale township in this section, where it was first discovered and used in the construction of the old Delaware and Hudson Canal.

The quarry sections illustrated are drawn to scale, and the strata are arranged as shown with a general inclination to the horizon of 45°; the formation extends a distance of about 3,600 feet on the property of Mr. Norton, the general direction of the out-crop being north and south; the southern portion, for about 2,000 feet, dips to the east and the northern portion to the west. The roof or dividing plane between the "cement" and the "bad rock" is remarkably smooth and well defined. These strata belong to the Lower Series or "dark cements" as classified by the geologists.

In the following sketch of the methods of manufacture adopted in the Rosendale region, we will confine ourselves to the works of Mr. F. O. Norton, illustrated, as typical of the most modern and improved treatment of the rock.

Black powder is generally used in the quarrying, this feature differing little from the practice in any other quarry, excepting that the rock is usually broken quite small. Tracks running at the foot of the slopes convey the broken rock to the bottom of an incline, from the top of which the cars pass by gravity directly to the kilns; these latter are ten in number, at Binnewater, of the usual Ulster Co. model, as illustrated. The cars have "dump" bottoms and by means of a turn-table and a track directly over the top of the kilns, charge the latter with rock without any further handling.

Pea-coal is used in calcining the rock, this last being arranged in the kilns in strata about 6 inches in thickness; the quantity and quality of the coal will depend of course greatly upon the character of the rock to be burned. These ten kilns will burn from 850 to 900 barrels of cement daily, the calcined rock being drawn twice in each 24 hours from the bottom of the kiln. Any portion not sufficiently burned is returned to the top of the kilns by an inclined hoist, shown in the sketch of the kilns, and the properly prepared portions elevated by another hoist to the top of the mill, where it passes into the "crackers," to be crushed to about the size of a hazel-nut. These crackers are made of cast-iron, and consist of three parts, the "shell" and the upper and lower "nut," the lower nut being chilled; both shell and nuts are provided with suitable grooves and flanges. The "shell" is about 15 in. in diameter at the top, and 6 in. at the bottom, and is about 18 in. high, and the shaft which carries the "nuts" is driven by steam power, through the medium of a belt, at a speed of 80 to 85 revolutions per minute. One "cracker" will crush about 250 to 300 barrels of cement per day, and each one will supply four sets of mill-stones 3 ft. in diameter. The Binnewater mill contains 16 pairs of mill-stones, each 3 ft. in diameter. One pair of these stones can grind daily from 65 to 70 barrels of cement, of 300 pounds each, to that degree of fineness that 93 to 95 per cent. of it will pass through a fine wire seive of 50 meshes to the lineal inch each way. The mills are almost identical in design with an ordinary flour mill, and in those described the under stone revolves while the upper one remains fixed. The ground cement passes directly from the mills into a long trough running along their base; in each longitudinal half of this trough is a screw-conveyor, the two running in opposite directions, and by these two conveyors the ground cement is carried to a central elevator or chain of buckets which lifts the cement to the top of the building, where another screw-conveyor takes it to the packing-room (see illustration). In the packing-room the cement passes down an inclined chute into a drum which contains a "flirt" or horizontally-revolving fan, and from this drum through six spouts the ground cement passes into the paper-lined barrels ready to be headed up and shipped for use.

Ordinarily one cubic yard of cement rock will yield 2,700 pounds, or 9 barrels of cement.

At Binnewater all the cement barrels are made upon the premises, a large building being devoted to this purpose, filled with the most approved machinery. The productive capacity of the works during the average working season of nine months, is about 200,000 barrels of cement.

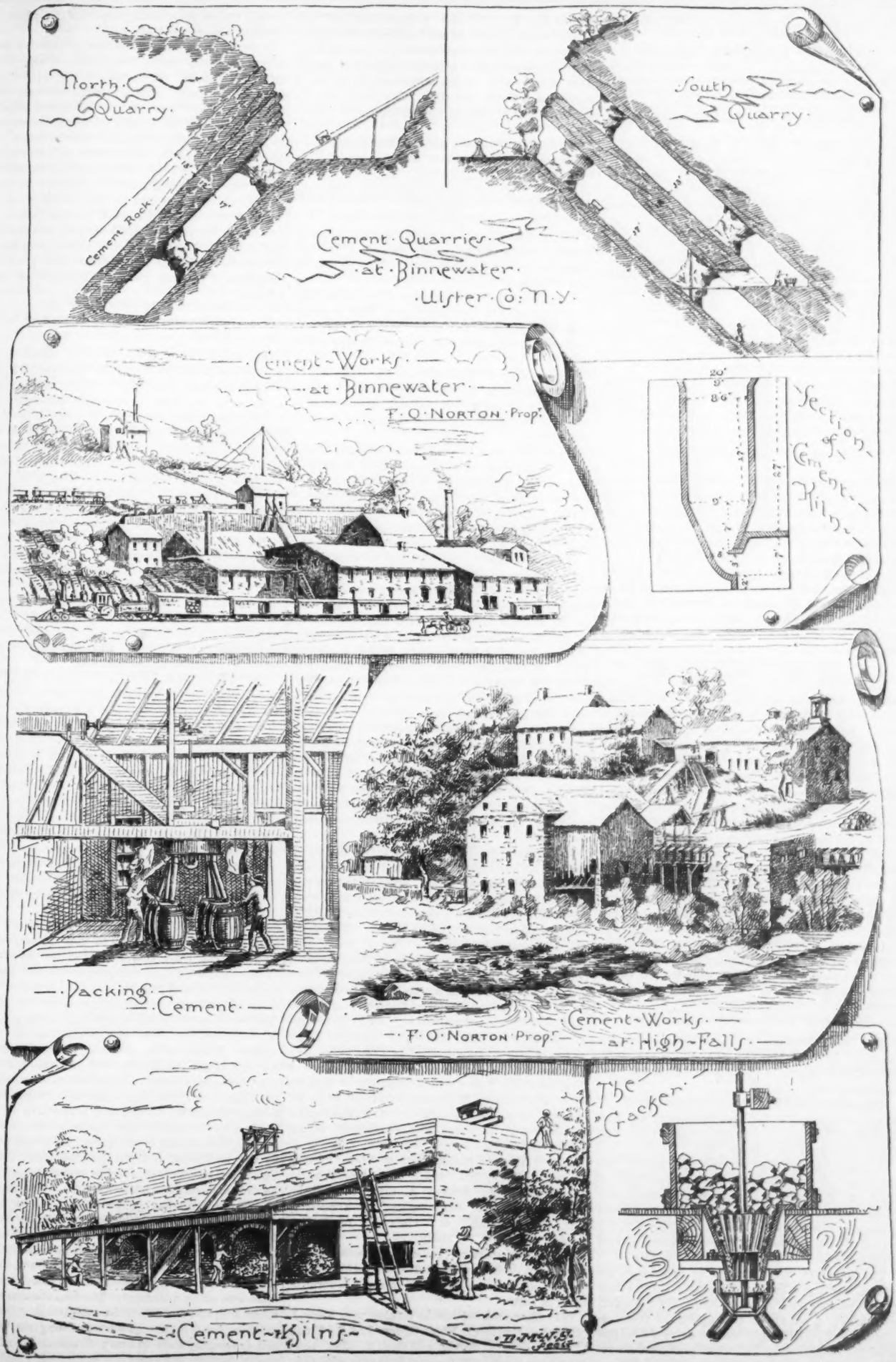
As the different strata of cement-rock vary in their hydraulic properties, care is absolutely required to produce a cement of uniform quality throughout the season, even when the material is taken from the same quarry. To attain this desirable end, at Brinnewater, the following is the method of procedure: *first*, no quarrying is done by contract, but by days' labor alone, so that all stone of inferior quality can be rejected at the quarry: *second*, the stone from the different strata are mixed together when they are loaded in the small cars for delivery at the kilns; *third*, by mixing it again when passing the cement rock into the kilns; *fourth*, it is again mixed up at the bottom of the kilns when the charges are drawn, and again in going into the "crackers," and again in passing from the "crackers" to the mill-stones; and finally the ground cement, by being conveyed in bulk into a large receiving bin at the top of the bucket-elevator mentioned, receives a seventh mixing before it passes into the barrels for shipment.

Each day's output of cement is hourly tested for tensile strength and fineness. Four briquettes are made each hour by a man detailed for that purpose, immersed in water, and broken at proper intervals upon a testing machine. In this connection, we notice an improvement in the briquette molds used by Mr. Norton, which tends to a greater uniformity of tests. The mold as usually made is a brass double circle, joined by the inch square segment which forms the testing-neck. With such a mold the cement briquette is necessarily removed while yet soft, and experience has proven that in the handling the soft briquette is often subjected to a twist and consequent strain that is the cause of very unequal results in the testing-machine. Mr. Norton obviates this by making his molds of wood, though brass could be used as well, and molds four briquettes at one time. The mold is in three pieces, held together at the ends by screw clamps, and the sections come apart on the line of the central axis of the briquettes in such a way that they may be allowed to remain in the mold until thoroughly set before removal.

As giving the results of conscientious care and intelligence in the modern manufacture of natural cements, especially as followed at the works examined, we append an extract from an official report made to Mr. Norton by Gen. Q. A. Gillmore upon the tensile and crushing strength of the Rosendale cement made at Binnewater:

"The cement was mixed up with water to the consistency of mason's mortar, and in that condition was put into the molds with a trowel. The specimens were left in the open air twenty-four hours after molding, and were then immersed in fresh water and left there until the day they were tested, care being taken to keep the temperature of the water at 65 to 70 degrees Fahrenheit. The tensile strength was obtained with briquettes having a cross section of 1½ inches by 1½ inches, equal to 2¼ square inches, and the crushing strength with two-inch tubes, prepared by grinding down to exact cubes the ends of the broken briquettes. The results given below were obtained by dividing by 2¼ the average tensile and crushing strength respectively, obtained from a number of trials.

	Age of specimen.	Crushing strength per square inch.	Number of trials.	Tensile strength per square inch.	Number of trials.
Neat cement.	Seven days	546 lbs.	15	104⅛ lbs.	5
Neat cement.	Thirty days	2,015 lbs.	15	134 lbs.	5
Cement, 1...	" "			102 lbs.	5
Sand, 1.....	" "				


North Quarry.
Cement Rock
South Quarry.
Cement Quarries
at Binnewater
Ulster Co. N.Y.
Cement Works
at Binnewater
F. O. NORTON Prop.
Section of Cement Kilns
Packing Cement
Cement Works
F. O. NORTON Prop.
at High Falls
The "Cracker"
Cement Kilns

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ENGINEERING ART AT THE NEW ENGLAND FAIR.—The Chandler Scientific School of Dartmouth College made a good display of engineering drawings in the art department of the New England Fair held in Manchester, N. H., the first week in September. The exhibit merited and received a prize. Some creditable oil, water-color and architectural sketches were shown. The first prize, a silver medal, for water-colors was awarded to H. W. Herrick, the talented designer of book illustrations, and the first prize for original architectural and engineering designs to Col. J. T. Fanning, of Manchester, the engineer and author.

PUBLICATIONS RECEIVED.

The annual "Report of the Supervising Surgeon General of the Marine Hospital Service of the U. S. for 1882," Washington, D. C.; the Fifth Annual Report of the Rhode Island State Board of Health, for 1882; the Tenth Annual Report of the Michigan State Board of Health, for 1882; the Report of the Minister of Agriculture for the Dominion of Canada, for 1882; "The Systematic Study of the Causes of Sickness and Deaths," by Henry B. Baker, M. D., Lansing, Mich.; "General Sanitation," by Henry B. Baker, M. D., Lansing, Mich.

A NEW EXCAVATING MACHINE.

V. D. Simar and John Dale, of St. Paul, Minn., have lately invented a new excavating machine that promises to do good work on the prairie roads of the West. It is a drag-scraper on wheels, run by steam-power. Six scrapers attached to an endless belt revolve about the end of a scraper-arm 20 ft. long; the earth is carried to an elevator that is fitted with a combination of cutters and buckets, and at the top of the elevator is a chute that can deliver the material anywhere within a radius of 20 ft. The whole machine is mounted upon a turntable, and the scraper-arm can be lowered to dig below grade or raised, as conditions may require. It can be used advantageously in borrowing from either side of the track, to widen track, or in wet work, which is handled with the same facility as dry earth.

There are two upright engines geared to develop 24 horse-power, and these, with boilers, weigh 2,700 pounds.

OHIO SOCIETY OF SURVEYORS.

The fourth annual meeting of this association was held in Columbus, O., Jan. 17, 18, 19, 1883. The printed report of their proceedings has just been received.

The officers for 1883 are: President, Fred. J. Sager, of Marysville, O.; Vice-President, Jonathan Arnett, of London, O.; Secretary and Treasurer, Benj. Thompson, of Urbana, O.

A Code of Instruction to County Surveyors was submitted by Jas. Newman, Secretary of State of Ohio, and at suggestion a committee was appointed to examine them and suggest such changes as were deemed advisable; B. F. Bowen, of Columbus, O., was made the chairman of this committee, and all proposed amendments should be sent to him.

The Secretary had intended to present at the annual meeting a Table of Magnetic Declinations for the various sections of the State, but the printed blanks sent out are so incomplete in their returns that it was thought best to defer the matter until the next meeting. All Ohio surveyors are requested to test the magnetic needle for declination on Oct. 20, 1883, once at least, and send the results with the latitude and longitude of the place as near as possible to the Secretary of the Society; they should give also the style and kind of needle used, and the hour of the observations; 8 a. m. is suggested as the proper time. Directions for observation will be sent on application to the Secretary.

The attendance at the meeting was large andthe affair was a success in every way.

THE AMERICAN WATER-WORKS ASSOCIATION.

We have received the printed report of the proceedings of the third annual meeting of this association as held at Buffalo, N. Y., May 15, 16, and 17, 1883.

We have already, in our issue of May 19, noticed in a general way the meeting of this body of hydraulic experts, but some further notice and remarks upon the present report will not be out of place.

To commence by finding fault, we must object to two features in the report just received: first, the lack of an index; and secondly, the neglect to properly edit the stenographer's report of the daily proceedings.

The report contains a reprint of valuable papers and tables of great interest, but they are scattered, and not as available for use as an index would have made them. To have avoided this omission would have cost but little additional trouble, and added much to the useful interest in the publication.

The stenographer was evidently an expert and faithfully put on record every remark made upon that occasion, and by so doing has included considerable matter that is of very little importance to the general reader. In reporting for a court of justice an absolute record of each and every word spoken may be necessary in the summing up of the case, and can properly be printed as being of interest to the legal fraternity; but in publishing the proceedings of a scientific body the end in view is a different one. The speaker should first have an opportunity of revising his remarks hastily thrown out in the heat of debate, and a chance given him to clear up obscure points, and at least to amend the phraseology so that it may be easy-flowing and grammatical; and the whole should then be ably edited and properly indexed. The solid substance is what is wanted, not the words.

From the report of the Secretary, Mr. J. H. Decker, we learn that there are now 84 names upon the rolls of the association. The papers read and discussed at the several meetings were as follows: "The Relative Economy of Constant vs. Intermittent Pumping," by Mr. W. C. Stripe; "The Methods of Filtration of Water in Use in the United States and Europe, with Details of Construction, Cost and Efficiency," by J. J. R. Croes, of New York; "The Relative Economy to Towns of a Supply of Water under Municipal Control and under Control of Private Corporation," by J. G. Briggs, of Terre Haute, Ind.; "Plumbing Work, its Effect on the Health of the Family," by Peter Milne, Jr., of Brooklyn, N. Y.; "Subsidence and Filtration of Western River Water, and Availability of Natural Flow into Filtering Wells and Galleries," by G. W. Pearsons, of Kansas City, Mo.; "How Important a Factor in the Economic Management of Water-Works is Engine Duty?" by Prof. Charles A. Smith; "How can the Quantity of Water Passing Through a Water Main which is in Operation be Ascertained?" by George A. Ellis, Springfield, Mass.; "Iron and Steel Tanks," by Thomas J. Bell, of Cincinnati, O.; "Records of Engine Duties," by Frank W. Holly.

The above papers are generally interesting and of value in their contents, but space forbids an extended notice; we expect to present several of them in full.

The officers elected for the coming year were J. G. Briggs, President; W. C. Stripe, J. J. R. Croes, L. H. Gardner, C. Schon, and Geo. A. Ellis, Vice-Presidents, and J. H. Decker, Secretary and Treasurer. Cincinnati was fixed upon as the place of the next annual meeting.

It would be well for the general good if we had more of these meetings of *specialists*, where individual views could be exchanged and individual methods discussed. Such associations must result in good; and by "pooling" the individual experience of members more rapid advance can surely be made in the profession under consideration. In professional life, as in trade, a man will often stick to the rut he is in rather than take the trouble to climb into the smoother and less-traveled paths on either side that may lead to wider and more useful fields of research. But contact with his more active fellow-worker may enlighten him, and furnish the otherwise lacking incentive to improve upon his old-time methods and venture into paths of professional progress that are to him yet unknown.

THE BUSINESS SITUATION.

The salient points in the business situation at present are favorable for manufacturing and producing interests generally; the few unfavorable features are not likely to seriously interfere with the swelling tide of prosperity or to check the producing capacity of consumers. Buyers in all departments of activity great and small, are coming into market, placing orders for material and merchandise of every description, as though the present volume of trade would be increased, and the present purchasing capacity of the people maintained at the highest limits it has yet reached.

The financial journals uniformly agree in reporting the money market sound, credit good, collections easy, the volume of business increasing, and the general financial condition of the country all that could be desired. Rates of interest are low and borrowers easily supplied. Bank credits are steadily expanding, but there is no such inflation as in former years has been the precursor of financial embarrassment.

The railroad situation is full of encouragement. Here and there it is probable that railroad reports are doctored up to suit the emergencies of the stock market, but, taking our railroad mileage as a whole, it is earning good dividends. There seem to have been very few mistakes made in railroad construction during last year. Capital is purchasing immense tracts of land along the lines of the roads just completed, and the out-flow of population into these new sections indicates that in a very short time, the agricultural traffic will be sufficient to make the roads self-sustaining. The railway journals exhibit reports which show that the trunk lines are earning good dividends and very few of them show a decline. The increase is from 5 to 50 per cent.

The completion of the Northern Pacific will attract capital and emigration to that great future empire. The early completion of the Southern Trans-Continental Line will open a wide field for the in-coming foreign population; but for years to come, the preference will be given to the great Northwest, where home and foreign markets may be easily reached, with the productions of that region. It is probable that the foreign demand for American breadstuffs will increase year by year, because of the advantages which this country possesses over India, Egypt and other foreign competing countries. This strong probability is recognized by the agricultural interests here and in Europe, as is shown by the taking up of vast tracts in the northwest and the projection of hostile legislative measures in foreign countries against general importations from America. The expansion of our agricultural capacity is opening up a wide market for the production of Eastern mills, factories and shops. Every fresh acre that is tilled calls for more iron and steel, more machinery, and more locomotive power and rolling stock. The prospects for American enterprise in this direction cannot be easily measured. The opportunities are unlimited, and the enterprise which is at work is reaching far into the capabilities of the great West, and developing them in every direction in which capital, energy and labor can be applied.

According to recent reliable statistics, it appears that the cotton crop for this year will be the largest ever raised, the estimates varying from 6½ to 7 million bales; the wheat crop, though less than that of last year, is very large, and the corn crop is larger than that of any year, excepting one. The favorable indications are adding to the sense of financial security and are broadening the foundation of our industrial and commercial activity. They are also opening the way for a further increase in railway construction, and capital and enterprise are only waiting opportunities for activity in this direction.

Expositions are in progress in Toronto, two in Boston, one in Pittsburgh, one in Cincinnati, and in Chicago and Louisville. This exposition fever is one of the out-croppings of American enterprise, and is doing more than any one thing to maintain the spirit of emulation which underlies all advancement. The displays of mechanical, agricultural and other products and resources at these expositions show that great progress is being made in every direction, and capital is finding great encouragement for further investments in the developments of the resources of which these displays are a fair sample.

Shipbuilding interests are pressing themselves upon the attention of capitalists, manufacturers, and those interests which are seeking foreign trade as an additional outlet for American productions. The increase in the total tonnage of iron and steel ships has been from 2,801 tons, built in 1868, to 21,346 tons in 1876, 40,097 in 1882. So far this year the tonnage has been 55,072 tons, of which 51 vessels were of iron and 5 of steel.

The cost of transportation is declining, both by rail and water. In 1868 the cost of lake and canal transportation from Chicago to New York was 25c. per ton, and in 1882, 8c. By lake and rail 29c. in 1868 and 11c. last year. By all rail, 42c. in 1868 and 14⅓c. last year. The steamer rates from New York to Liverpool in 1868 were 14c. and are 7½c. now. These facts should be more attentively considered by the agitators for governmental control over our railroads. American enterprise and capital are abundantly able to solve all the industrial problems likely to be presented without governmental interference.

The tariff question may be regarded as permanently settled for the present, excepting as to isolated cases. The American Tin Plate Association will make a strong fight for a heavy increase of duties, sufficient to enable that industry to establish itself. The reductions, which went into effect July 1, have brought very little advantage to the foreign manfacturing interests, owing to the prompt action of American manufacturers in reducing the cost of production below importing prices.

The iron and steel interests are fairly active, but the possibility of over-production is leading to a very conservative course of action by both manufacturers and consumers. Iron and steel are lower than ever before. The market is scant of supplies, because of the efforts of producers to supply only as much as will be required. Merchant iron is selling at 1.75@2¼c. per lb.; crude iron is $17@$23, according to quality; construction iron is 2½@3½c. per lb.; nails are $2.75@$3 per keg, and steel rails, $38@$39 per ton. The outlook for railway construction is favorable for a moderate activity during the coming year, and with the expansion of population and wealth-producing capacity, it is probable that the demand for steel rails will continue to employ the full capacity of all our American mills. In commercial circles, complaints are made of slack trade; in some industrial channels, manufacturers speak of stagnant demand. In some financial quarters, complaint is made of the lack of demand for money, but, taking into account all the conditions which surround the commercial and industrial interests of the country, the merchant, and manufacturer, and banker, and railroad manager, must admit that the prosperity which exists is all that can be desired, and that the conditions for the development of the industries and trade, will likely carry us over any temporary obstacles, and maintain the healthy activity which has been enjoyed during the past four years.

LAST REPORT OF THE BOSTON WATER BOARD.

The Boston Water Board, on Sept. 10, submitted its annnal report, from which we make the following abstracts:

The total available amount of water in the Sudbury River basins on Sept. 1 was 810,000,000 gallons; in Lake Cochituate, 510,000,000 gallons. At the present rate of consumption, these supplies will be exhausted in about forty-five days. At Mystic Lake the quantity available above the pumping point is 138,000,000 gallons, or about thirty days' supply. The daily average consumption from the Sudbury and Cochituate works for the month of August has been about 36,000,000 gallons, an increase of 8 per cent. over the same period for last year; from the Mystic works, 7,290,000 gallons, an increase of 5.5 per cent. over August of last year, and at the Highland station, 3,168,000 gallons, an increase of 5.1 per cent. over August of last year. The average yield of the Sudbury River for the past month has been 5,900,000 gallons per day, and that of the Mystic Lake about 3,000,000 gallons. Lake Cochituate has lost, by evaporation and soakage, 50,000,000 gallons more than it has received from its water-shed.

The present season is the dryest that has been experienced for thirty years, and though early in the year the water in Lake Cochituate was nearly at high-water mark, it has gradually fallen to a point where the supply can hardly be maintained. The surface of water in the lake is now only 7½ ft. above the bottom of the aqueduct.

In regard to the pollution of the Cochituate and Mystic supplies, the report states that the complaints of impure and bad-tasting water are not altogether due to shallow and imperfectly constructed basins. The steady growth of industrial enterprises in the towns whose drainage empties into these sources, together with the introduction of independent water supplies, have so increased the flow of sewage into the water courses as to create a very serious and growing evil. In the Mystic department the present outflow of sewage through the sewer built by the city, and which otherwise would go into the Mystic basin, is 300,000 gallons every 12 hours. This is largely the refuse of tanneries and glue factories, and by law the city is obliged to so treat all this sewage that it shall not create a nuisance by its flow into tide-water. The board has examined the Farquhar-Oldham Filtration Process, and has accepted a proposition from the American Filter Co. to put one of its machines at Mystic Lake for the purpose of testing its value under the present conditions.

Pegan Brook, which flows into Lake Cochituate, furnishes a much contaminated supply. Within the last twenty years large factories, a gas-house and hotels have been built upon it; and these, with the natural increase in population, and a new town water-supply, have so added to the sewage flow that from 300,000 to 600,000 gallons are emptied into the brook every 24 hours. The point of entrance of this matter is only one mile from the lake, and this addition of impure material, if not positively dangerous, must be at least injurious.

The construction of the new Basin 4, at Ashland, is being pushed forward under Mr. W. Learned, the engineer in charge. The total appropriation for this work is $690,000, of which amount there is an unexpended balance of $390,256.92.

Very considerable work has been done in deepening Basin 2. The deepening of Basin 3, for which $125,000 was appropriated, can not be commenced until Basin 2 is finished. The Chief Engineer, Mr. Wightman, has completed the plans and specifications of the Pond Farm Conduit, for which $160,000 has been set aside; and the preliminary work will be entered upon later in the year.

The report calls the earnest attention of City Councils to the Highland high-service works. The present system was devised in 1869 for the Roxbury district, and since that time the area of high-service supply has increased from 760 to 10,720 acres. They recommend that work on a new high-service system be at once commenced.

A new system of inspection for the prevention of waste among consumers has been devised, and the inspection work began July 16, 1883. The system adopted promises to work well.

By a vote of the former Water Board, passed on Feb. 27, 1883, the Deacon waste-detectors, which had been used in Charlestown, were, as soon as the season would permit, placed in East Boston. Early in April these machines were set in operation. Very satisfactory results have been reached. The daily average consumption from the high-service works (which supply about three-fourths of the population of East Boston) was 276,880 gallons during the month of July—a reduction of 152,640 gallons, or 36 per cent. less than the corresponding month of 1882. Immediately after the appropriation of $25,000 for waste-water detectors was made the Board determined to utilize the Deacon and similar systems as far as possible, and early requested the City Engineer to assign Mr. Dexter Brackett to this branch of the service.

In accordance with the recommendations of Mr. Brackett, nine additional Deacon meters have been purchased. Mr. Brackett, who has entire charge of this work, is setting these meters in the city proper, and has already used several of them in conjunction with the division of inspection and waste.

In June, 1883, the City Councils appropriated $50,000 for the purchase of recording water meters, there being already in use at that time about 2,500 meters of various patterns in the city; more than one-third of the total water revenue for 1882 being derived from water measured through meters.

Before expending the sum named a meter division was created, of which Mr. Hiram Cutts, the former superintendent of the Mystic Department, was made chief. The testing and examination of the several meters was under his control, under the supervision of Mr. O'Brien, chairman of the Board of Aldermen. Five of the meters tested by Mr. Cutts had before given practically the same results, as reported by him; two of them had been tested with more favorable results than the five first mentioned; but in none of these were the tests applied as to obstruction, as in the present instance; of the four remaining meters none had been previously tested. The meter adopted by the Board was the one owned by the Tremont Meter Company, and is known as the Sweeney meter; it is said to be the oldest patented meter.

The Tremont Meter Co. is under a bond of $20,000 to fully protect the city, and to guarantee the proper and faithful performance of their machine, to replace imperfect machines, and to save harmless the city against any and all actions, either legal proceedings or claims, for any infringement of patent. The Board has ordered to date 1,577 meters of various sizes at a cost of $34,155.50.

The report closes by recommending that a salary of $1,500 per annum be paid the city engineer in addition to his official salary as such; the sum named to compensate him for his services as Engineer to the Water Board, and to be paid out of the different appropriations at the disposal of this board.

THE NORTH PACIFIC RAILROAD.

The opening to public travel of this the last connecting link between the Pacific and the Atlantic States closes a chapter of railroad history teeming with unusual and diversified experiences.

The history of the North Pacific Railroad dates back to the Act of Congress passed March 3, 1853, which authorized the employment of the United States Topographical Engineer Corps to make such explorations and surveys as were deemed advisable, and "to ascertain the most practical and economical route for a railroad from the Mississippi River to the Pacific Ocean," and appropriated $150,000 to this purpose. Jefferson Davis was then Secretary of War, under President Pierce, and preparations were at once made for the survey of four distinct railroad routes. The first was to

follow a line between the 47th and 49th parallels, north latitude; the second between the 41st and 42d parallels; the third, a line between the 38th and 39th parallels, and the fourth near the 35th parallel. These are now all substantially occupied by great trunk lines; the Union and Central Pacific follow nearly the 41st parallel; the Atlantic & Pacific, now under construction, is about on the 38th; the Texas & Pacific near the 35th; and now the Northern Pacific is completed in the immediate neighborhood of the 48th parallel.

Under the original act the chief responsibility for the examination of the northern line rested upon Gov. Isaac I. Stevens, of Washington Territory, who was himself a skillful civil engineer; and among the army officers who participated in the survey was Gen. George B. McClellan, who personally examined the various passes through the Cascade Range and the Cœur d'Alene Mountains. According to the official instructions from Governor Stevens, the survey was to proceed westward commencing at St. Paul, and a tolerable thorough reconnoissance was made from St. Anthony's Falls to Puget Sound.

The report of Secretary Davis upon the four routes examined is interesting reading at this day even. Being a Southerner, he looked at all national undertakings through Southern eyes, and, though well concealed, his purpose undoubtedly was to use his influence in securing, first of all, the construction of a railroad on the 35th parallel, so that a belt of "Slave States" could be established across the continent before the North could have time to extend the "area of freedom" beyond the Missouri. Under date of Feb. 7, 1855, Mr. Davis reviews the several routes, in his official report addressed to the Speaker of the House, and recommends the Southern route, for its low grade and easy mountain passes, and objects to the building of the Northern lines, because the natural conditions are just the reverse, "coupled with a severely cold climate." He estimated the cost of the Northern route from the reports at $140,871,000, and the distance from St. Paul to Vancouver was put down at 1,864 miles. The sum of ascents and descents, as far as was reported, was 18,100 ft. Secretary Davis summed up his own views in the following language:

"A comparison of the results stated above, and those in the tables referred to, conclusively shows that the route of the 32d parallel is, of those surveyed, 'the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean.' This is the shortest route; and not only is its estimated cost less by a third than that of any other of the lines, but the character of the work required is such that it could be executed in a vastly shorter period. It is obvious that a road on any of these routes, with the exception perhaps of the 47th parallel, must be built continuously from the two extremities, and an obstacle that arrests its progress at any point defers the commencement of all the work in advance. The tunnels and much of the other work on the more northerly routes in the most desolate regions are such as could not be commenced until a road was constructed up to those points, and would then require a long period for their completion. On the southernmost route, on the contrary, the progress of the work will be regulated chiefly by the speed with which cross ties and rails can be delivered and laid, the nature of the country being such that throughout the whole line the roadbed can easily be prepared in advance of the superstructure. The few difficult points, such as the pass of the Guadaloupe and Hueco mountains and the passes between the Rio Grande and Gila, will delay the work but an inconsiderable period. This peculiarity of the ground presents another advantage in the fact that temporary tracks could be laid upon the natural surface of the earth to almost any extent to serve for the transportation of material and supplies. The climate on this route is such as to cause less interruption to the work than on any other route. Not only is this the shortest and least costly route to the Pacific, but it is the shortest and least costly route to San Francisco, the greatest commercial city of our Western coast, while the aggregate length of railroad lines connecting it at its eastern terminus with the Atlantic and Gulf seaports is less than the aggregate connection with any other route, as will be seen by reference to the appended Table B. With regard to the circumstances which affect the cost of working and maintaining the road, they are more favorable than on any other route. In this dry climate the decay of cross-ties and other timber would be very slow, and the absence of severe frost would have a most important influence upon the permanence of the roadbed, and heavier grades could be adopted than in a climate where snow and ice prevail. The snows on all other routes, except that of the 35th parallel, could not fail at certain seasons to suspend the working of the road, for on all such snows are known to have fallen as would interpose an effectual barrier to the passage of trains. Such an occurrence in this desolate region would be attended with more serious consequences than inhabited districts. In only one important respect is this route supposed to be less favorable than some of the others, and that is in the supply of fuel; the difference, however, in favor of the others is not great, unless the existence of coal at certain points along these routes where it is indicated should be verified by further examination. The cost of fuel is about one-fifth of the whole expense of maintaining and working a railroad."

The usual legislative debate and conflict of interests delayed the consummation of this scheme, until five years later when the civil war broke out and removed forever the question of the territorial boundaries between slave and free States. Early in the eventful years of 1861–1865, the people of the North determined that the construction of one or more railways to the Pacific were necessary for the perpetuation of the Union, in other words the 2,000 miles of wilderness then intervening must be removed. Accordingly Congress chartered three railways across the "Great American Desert," that is, the North Pacific, the Union and Central Pacific, and the Atlantic & Pacific. The chairman of the select committee on the Pacific railroads, for the 38th Congress, was Thaddeus Stevens, the "Old Commoner" of Pennsylvania; Jas. Harlan, of Iowa, was at the head of the Senate Committee. The act embodying the North Pacific Railroad was approved July 2, 1864, and bears the signature of Abraham Lincoln, President of the United States.

The list of corporators named in the bill embraced 148 names of prominent men then resident in most of the Northern cities. Among them we find Richard D. Rice of Maine; Willard Sears, Josiah Perham of Massachusetts; George Opdyke, Chauncey Vibbard and John C. Fremont of New York; S. M. Felton, George W. Case, J. Edgar Thomson and John A. Green of Pennsylvania; Onslow Stearns and William E. Chandler of New Hampshire; Cyrus Aldrich, H. M. Ross, John McKusick, H. C. White and Stephen Miller of Minnesota; John Gregory Smith and George Merrill of Vermont; U. S. Grant, William B. Ogden and Leonard Swett of Illinois; John Brough, John A. Bingham, Oran Follett, H. G. Blake and Philo Chamberlain of Ohio; J. C. Ainsworth and H. W. Corbett of Oregon; J. B. S. Todd, M. K. Armstrong, J. Shaw Gregory and J. L. Berge of Dakota Territory.

The capital stock of the company was to be 1,000,000 shares of $100 each, and the charter conferred upon the company a grant of public lands, consisting of 20 sections per mile on each side of the track in the territories, and 10 sections on each side of the track in the States. This is equivalent to about 23,000 acres for each mile of road, or a grand total of 56,000,000 acres, nearly 90,000 square mile, an area equivalent to about three-fourths of the Kingdom of Great Britain; this land grant was in addition to the right-of-way of 200 ft. along the entire length of the line. Work was to be commenced within two years from the approval of the Act by the President, and the road was to be finished by July 4, 1876. This first charter was amended May 7, 1866, by an extension of time for two years; and was again amended July 1, 1868, by an additional extension of two years. By act of March 1, 1869, the right was conferred upon the company to issue its bonds and secure the same by mortgage upon its railroad and telegraph lines; this was for the purpose of raising funds for the construction. By public Resolution No. 44, dated March 31, 1870, the charter was still more radically amended by allowing the construction company to also mortgage the land grants conferred by Congress, even before the building of the road which made good their title to these lands. The passage of this act was bitterly opposed by a powerful minority in both houses, and though triumphantly passed, gave rise to much political scandal in that day, from the means reported to have been used to secure its passage.

Josiah Perham, the first President of the North Pacific Co. under the original organization, was elected in Boston Dec. 6, 1864, and for four or five years labored incessantly, but in vain, to interest capitalists in the construction of the road. In 1869 he was compelled to turn it over to a new set of men, of whom Gov. John Gregory Smith, President of the Vermont Central R. R., was the leading spirit. In 1869 Gov. Smith laid the matter before Jay Cooke, then famous for his successful negotiations of government securities, and Mr. Cooke being favorably impressed with the scheme, made a prelimary contract to handle the bonds of the company. The first new departure suggested by Jay Cooke, who now became the leader in this enterprise, was to place W. Milnor Roberts, the eminent and veteran Civil Engineer, in general charge of a re-survey from the head of Lake Superior to Puget Sound. General W. S. Hancock was then Military Commander of the Northwest, and having just returned from an extensive tour along the Missouri and Yellowstone, was to furnish the needed information as to these sections. Mr. Roberts submitted his report to Mr. Cooke on Sept. 5, 1869, in a pamphlet of 50 pages, making a most favorable report.

Upon the basis of this report Mr. Cooke advised his firm to close a contract with the railroad company to act as their fiscal agents. The enterprise, which was not yet amended by the act of 1870, was divided into 24 equal parts, J. Gregory Smith and his associates held 12 parts, and Jay Cooke & Co. 12 parts. The result of this negotiation was to put into the company's treasury $6,000,000 in money, and thus permit construction to be at once begun. Jay Cooke & Co. did not take all of the $80,000,000 of capital stock at the disposal of the company and his firm ($20,000,000 of the original $100,000,000 had been set aside to use as commissions to aid in the negotiation of mortgage bonds), but formed a strong syndicate of leading bankers and railroad men in Pennsylvania, New York and New England, who took larger or smaller portions in the "ground-floor" pool. Jay Cooke threw all his energy, skill and experience as a financier into this North Pacific scheme, to which he now stood firmly committed. Early in 1870 ground was broken at Thomson's Junction, 20 miles from Duluth, and the work was then energetically pushed.

Under the the re-organization of the board of directors following the advent of the Cooke management, the following men were elected directors and officers:

BOARD OF DIRECTORS.

J. Gregory Smith, St. Albans, Vt.
R. D. Rice, Augusta, Me.
Thomas H. Canfield, Burlington, Vt.
William B. Ogden, Chicago, Ill.
William G. Moorhead, Philadelphia, Pa.
William G. Fargo, Buffalo, N. Y.
B. P. Cheney, Boston, Mass.
George W. Cass, Pittsburgh, Pa.
Frederick Billings, Woodstock, Vt.
William Windom, Winona, Minn.
James Stinson, Chicago, Ill.
Samuel M. Felton, Philadelphia, Pa.
Charles B. Wright, Philadelphia, Pa.

The officers of the company under this organization were as follows:

J. Gregory Smith, president.
R. D. Rice, vice-president.
Samuel Wilkeson, secretary.
A. H. Barney, treasurer.
W. Milnor Roberts, engineer-in-chief.
Edwin F. Johnson, consulting engineer.

In pushing the construction of this road and in finding cash to pay for the construction, the chief difficulty was in combatting the dense ignorance which only thirteen years ago almost universally prevailed as to the character of the climate and country through which it was proposed to run the North Pacific Railroad. It was hard to convince the masses at home and abroad that it did not run through Labrador or Alaska. In the efforts of the financial agents to enlighten the people as to the true condition of affairs, the Northern States were soon almost knee-deep in North Pacific literature: by newspapers, broadsides, maps, plans, photographs—in every conceivable way, in fact, the location, surroundings and future of this road were kept before the public; it was even then charged that it was preached from the pulpit. Opposition arose too from conflicting interests, and from publications whose only object was to obtain a price for their approval, and the jealous enmity of riva banking firms had also to be considered as an element of discord.

In Wall street, Mr. Rufus Hatch, to-day the most noisy among the singers of the praises of this road, was then one of the most virulent of its assailants. Mr. Hatch, among other devices, circulated an ingenious burlesque upon the first prospectus of the 7.30 North Pacific bonds, and referred to the road as the "North Pole & Hudson Bay Railway." Drexel & Co., of Philadelphia, were also its bitter enemies, though now they are its fiscal agents in New York, London and Paris.

But another enemy was about to appear upon the scene, more powerful for evil than the combined machinations of rival bankers and the jealous or corrupt press, and that was the general distrust of securities that began to creep through the business community in 1873. A financial revolution was about to take place, and an inflated and irredeemable paper currency was to be got rid of, and a coin standard once again resumed. Jay Cooke & Co., finding the bonds slow of sale, had advanced heavily from their own funds to enable the construction to be continued and the contracts to be fulfilled, and were first warned of the approaching storm, early in 1873, by the failure of several railroad companies and banking firms with which they were connected, and after a manly struggle they found themselves so entangled with their vast and far-stretching interests that resistance was in vain. On Sept. 18, 1873, the firm of Jay Cooke & Co. suspended payment and precipitated the financial crash of the memorable year of 1874. At the time of the suspension the company had outstanding $25,000,000 of its first mortgage bonds and had a floating debt of $2,000,000 or $3,000,000. The company passed into the hands of a receiver, having necessarily defaulted on the payment of the January, 1874, interest on its bonds, and Geo. W. Case was appointed to the position. After a hopeless struggle and efforts to rally, the directors decided in 1875 that there must be a foreclosure of the mortgage and a reorganization of the company. This was accomplished by an amicable suit in the United States Court.

Under this new deal the capital stock of $100,000,000 was divided into two classes of equal amount, or 50,000,000 of common stock and 50,000,000 of preferred. The preferred stock was at once issued to the holders of the company's bonds, and the bonds called in and canceled. The common stock remained as the property of the former stockholders, who thus preserved their interest by cutting down their ownership one-half. Under the reorganization, Chas. B. Wright, of Philadelphia, was made President, and his administration was able and economical. In 1878 Mr. Wright resigned, owing to ill-health, and was succeeded by Mr. Frederick Billings, who was then the largest single owner, and had become a leading spirit in the reorganization. Mr. Billings was president until 1881, and by his efforts the company had attained a pretty firm financial basis, a new mortgage had been placed, and some $6,000,000 had been raised, and work was progressing. In 1881 Mr. Henry Villard appeared upon the scene. He already had large interests in the Oregon and Washington Territory system of railroad and steamboat lines, and conceived the plan of obtaining control of the North Pacific R. R., and thus practically uniting the systems. To accomplish this end he formed in Wall street in 1881 what has since become known as the celebrated "blind pool," by which $10,000,000 was placed in his hands by parties who had no definite information as to what he intended to do with it; the money was simply invested upon his assurance of the feasibility of a certain project. With this capital, backed by his private means, he gained control and made himself President of the North Pacific Railroad, to the astonishment of the former owners. From that time forward the construction was vigorously pushed to its present successful termination.

CORRESPONDENCE.

MEASURING HOWE TRUSS BRIDGES.

SPRINGFIELD, Mass., Sept. 10, 1883.

EDITOR ENGINEERING NEWS:

In regard to the query in your last issue regarding Howe Bridges.

Being the direct successor of the original Howe Truss Bridge Builders, and having been in the business for over twenty years, I would say that the invariable practice, so far as I know, is that the price is for full length of chords.

Truly yours, R. F. HAWKINS,
Per Burrall.

HORIZONTAL VS. GRADE MEASUREMENTS.

FLORENCE, Colo., Sept. 6, 1883.

EDITOR ENGINEERING NEWS:

DEAR SIR: I have heard it contended quite often that proper track measurement is along center line of track on the grade of same and not horizontally, the argument being that by using horizontal measurement on curves where the grade is considerable, a much longer chord is attained than calculation requires. Would like to hear some argument on this subject. Very truly, etc.,

A SUBSCRIBER.

[This is a considerably debated subject and we would be glad to hear from some of our correspondents in relation to the matter.—EDITOR ENGINEERING NEWS.]

CORRECTION.

ST. PAUL, Minn., Sept. 11, 1883.

EDITOR ENGINEERING NEWS:

In your issue of Sept. 8 you credit us as from Stillwater, Minn., whereas it should be Council Bluffs, Iowa, and St. Paul, Minn. Besides the 3 150 ft. combination spans over the St. Croix River we have just closed contract for pile and caisson foundation work for the new bridge across the Mississippi River at Minneapolis for the St. Paul & Northern Pacific Railroad, and have just completed two iron spans of 128 ft. each, double track, and three double-track girder spans of 40 ft. each for the Manitoba Railroad as the western approach to the stone viaduct being built across the river by that company at Minneapolis. Yours truly,

RAYMOND & CAMPBELL.

PERSONAL.

CAPT. ADOLPH KNIPPER, Superintendent of the New Water-Works extension of St. Louis, died last week in that city. He was sixty years of age.

MR. MILLER, connected with the Government Surveying Corps, of the Wabash River, was lately shot in the head at Vincennes, Ind.

POULTIER B. ROBERTS, Engineer of the English Government at Calcutta, was in Chicago last week for the purpose of examining the Chicago system of Public Works.

COL. J. T. FANNING, the hydraulic engineer and author, received the first prize for original, architectural and engineering designs at the New England Fair, held recently in Manchester, N. H.

MR. O. R. WHITNEY, for the last two years Chief Engineer of the Lehigh Valley Railroad Company, has resigned to accept the position of Chief Engineer of the West Shore Railway Company's ferries at New York City.

MR. CAMPBELL.—We find the following in the *Denver Tribune:*

"Professor" Campbell, chief of the bridge-building department of the Union Pacific, arrived yesterday from the Oregon Shortline, along the course of which he has put in a number of fine bridges. He has also traversed the Wood river country, and makes a glowing report concerning it.

F. COLLINGWOOD, late Assistant Engineer on the East River Bridge, is engaged in repairing the cables at the anchorage of the Allegheny suspension bridge, connecting the cities of Allegheny and Pittsburgh. These cables have not been examined for twenty-five years, and now it is found that some of the wire is badly rusted and some quite useless. It will take several months to make the necessary renewals.

LAWRENCE, Kansas, Sept. 8.—In your issue of last week, under the head of "Personal," you say that Prof. NICHOLS has taken the position here as Professor of Engineering. This is a mistake. He holds the chair of Physics and Astronomy, taking the place of Prof. H. S. S. SMITH, now of Princeton. E. A. S. BAILEY, lately of Lehigh University, takes the chair of Chemistry. The Engineering Department promises well for the coming year. I send you a catalogue. Yours, etc.,

F. O. MARVIN, Prof. Civil Engineering.

MR. OLAF HOFF, formerly with the Keystone Bridge Company, at Pittsburgh, Pa., and more recently with the Mexican Central Railroad Company at Tampico, Mexico, as Assistant Engineer, arrived in New York on the 10th from Tampico. Mr. HOFF reports railroad business in Mexico as very dull at present, and the City of Mexico swarming with unemployed engineers. Mr. HOFF gave up his position on account of severe chills and fever which he had contracted, and came by sailing vessel to obtain the benefits of the voyage. He is quite recovered, and will go to Stoughton, Wisconsin, in a few days.

MR. GOULD'S library is one of the most remarkable things about that remarkable man. Not only does it contain all the standard classical works on history, science, finance, and the usual collection of romance, fiction and poetry, but in certain glass cases, well guarded with strong wire network outside, tomes of immense value and great age, and many an *editio princeps* which would delight the heart of a bibliophile. This room is the one place which is thoroughly sacred. It is the Holy of Holies of the millionaire, the mysterious chamber which Bluebeard forbade even the wife of his bosom to enter. No person except Mr. GOULD is allowed to touch his precious books even his factotum, Morosini, avoiding that dangerous ground. With all his business cares Mr. GOULD is a close student, and is singularly well versed in general literature. A well-known New York lawyer once said of him that he was the best authority on the law of corporations in the United States.

NEWS OF THE WEEK.

THE DUTY ON IRON RODS.—One of the most important questions awaiting the decision of Secretary Folger is what rate of duty shall be assessed upon iron rods. The Collector at Boston has ruled in favor of the higher rate of duty, the Collector at New York in favor of the lower rate, and both sides have appealed. The wire rod manufacturers of course desire to have the higher rate fixed, and those who make wire-rod goods want the lower rate. Considerable money is involved.

DENVER'S ARTESIAN WELLS.—A dispatch says: The artesian well at the Windsor Hotel at a depth of 515 ft. struck a flow of water, which at the surface of the ground has a pressure of sixty pounds to the square inch. This is sufficient to raise the water in the pipes to a height of 120 ft. The well is now flowing at the rate of 300,000 gallons in

twenty-four hours. Further work on the well has been abandoned, as the supply is vastly in excess of all possible demands. The bore is 10 in. in diameter at the surface and 5½ in. at the bottom.

There are at present fifty wells of this character all flowing freely. The Windsor well is the only well that goes deeper than 350 ft. The supply of this water seems inexhaustible. This discovery will probably lead to the boring of many wells on plains, and vast areas of land will be brought under cultivation if equal good luck attends further attempts.

A PROPOSITION to improve Chicago sewerage has been made by a gentleman. He says: "I propose for $2,000,000, more or less, to remedy the sewerage system of Chicago. My plan would be to construct a conduit on either North Water or Kinzie street about 12 ft. in diameter, commencing at about 6 ft. below the surface near the North Pier at a grade of about 5 ft. to the mile, to pass under the river and meet one of a similar size on Canal street, and the Canal street one to be about thirty or more feet below the present surface, and to be carried under the river or South Branch to meet Stewart avenue alongside of the Fort Wayne track; and the present engine lately put at the locks at Bridgeport to be moved to the bank of the river at Stewart avenue to elevate the sewage sixty or more feet and send it in a large sewer to Dolton or Globe station, there to be rendered into butter guano and other useful articles by Brenock or a section of the bridewell force. The ends of all the present sewers are to drop into this conduit, and the ends of the South side sewers to be connected by superheated iron pipes under the river to connect with the one on either Canal or Kinzie street."

THE MINNEAPOLIS & SAULT STE. MARIE R. R.—A surveying party of eighteen men left Minneapolis on the 1st to begin the work of surveying of the Minneapolis, St. Marie & Atlantic Railroad through Wisconsin.—It is understood at St. Paul that the proposed new railroad from Minneapolis northeast to Florence, Wis., to be known as the Minneapolis, Sault Ste. Marie & Atlantic Railroad, is to form a part of the Northwestern system, and is in reality a Chicago & Northwestern enterprise.—Mr. E. M. Spaulding, a civil engineer from Milwaukee, has arrived at Florence, Wisconsin, an will take an exploring party through the wilderness from there to St. Paul in search of a feasible air line for the new Minneapolis, Sault Ste. Marie & Atlantic Railway. The distance is 225 miles, almost directly west. Three exploring parties have been put in the field, and Florence is to be the eastern terminus in Wisconsin.—J. E. Shields, chief engineer of Minneapolis & Sault Ste. Marie Railway, has started out over the line and will examine the proposed route as far as the eastern boundary of Barron County, Wis. Two other parties will traverse the line between Barron County and the terminus of the road at Sault Ste. Marie. The three parties will probably remain in the field for two months.

A SUIT FOR BURNED BRIDGES.—Peter Cullen, Chief of Police of Reading, Pa., has sued the Philadelphia & Reading for $10,000. The suit has been going on for five years. During the railroad riot of 1877 the Lebanon Valley bridge, spanning the Schuylkill River, was destroyed by the rioters. The railroad company offered $10,000 for the arrest and conviction of the bridge burners, and $5,000 more for the conviction of persons destroying its property. Chief Cullen ran down one of the guilty persons, Samuel Humphries, in Connecticut. Smith, another rioter, was captured up the Hudson River. Both were brought to trial and were sentenced to five years' imprisonment. Mr. Cullen naturally expected his reward, but the company did not see fit to pay it, alleging that the arrest of the bridge-burners was in the line of his duties as Chief of Police. Owing to the absence of Mr. Gowen the case was postponed to the November term.

BRIDGE ACROSS THE ROCK RIVER.—The Chicago, Burlington & Quincy has just completed a bridge across the Rock River at Sterling which gives that road a direct line into Sterling, Ill., from Chicago. The bridge is a substantial structure and cost about $500,000.

THE ST. LAWRENCE BRIDGE.—The promoters of the Ottawa, Waddington and New York Railway and Bridge Company have been informed that the Dominion Government object to the construction of an international bridge across the St. Lawrence at Ogden's Island, above Morrisburg. Their charter empowers the company to construct a bridge at that point; but it is asserted that any obstruction in the river would seriously interfere with navigation. The bridge would cross the Plat Rapids, which are run by all down vessels, and which passenger-boats ascend safely. High-masted vessels, rafts, and barges also pass down these rapids, and as they cannot be guided in such a current, they would be in danger of being dashed to pieces against the piers. The bridge company contend that such craft as cannot pass under their bridge can pass through the canal.

RAILWAY CONTRACTS LET.—It is said that contracts for the completion of forty miles of the Topeka, Salina & Western west from Topeka have been let, and that the contractors are to be put under bond to have the road constructed that distance by Dec. 1. That would carry the road eight miles west of Alma, or within twenty-five miles of Council Grove; with forty miles west from Topeka completed, and twenty-three miles west from Council Grove.

THE ATLANTIC & PACIFIC RAILROAD Company has made application for three commissioners to inspect 150 miles of completed road in Arizona.

THE SPRINGFIELD (MO.) WATER-WORKS.—SPRINGFIELD, MO., Sept. 10.—The water-works, being constructed by R. B. Perkins, at a cost of $150,000, are about completed. Water is being pumped into the reservoir, and this afternoon the water was turned into the mains.

A PILE-DRIVING CONTRACT.—A hearing was had before Judge Fell in Philadelphia this week on a demurrer to the bill of the Isaac Neveling Pile-Driving Company, asking for an injunction to restrain Isaac and Harry Neveling from collecting moneys on account of a contract with the government that they assigned to the plaintiffs. Pierce Archer, counsel for the defendants, argued in support of the demurrer that the assignment was void in law; that the bill shows no equity in the plaintiff, it not appearing that the plaintiff had advanced money, labor or materials to the defendant or contributed in any way anything of value to the business, and because the bill averred that the defendants had already collected $33,000, the full amount of the contract purporting to have been assigned. In an answer filed the defendants declared that the contract was their individual property and still is, and the paper purporting to be an assignment was made more than six months after the company defendant had been formed. Any assignment, they aver, is not only forbidden by the words of the contract on its face, but also by the act of Congress of 1853. The assignment was made merely as a protection of the plaintiffs, who had bought about $25,000 worth of lumber from a company in which the defendants were interested, and was not to be regarded as an absolute transfer. The Court sustained the demurrer and dissolved a preliminary injunction granted last week.

THE SALINA, LINCOLN & FREMONT.—The surveys are all complete between Salina and Nebraska City, at which point the Salina, Lincoln & Fremont is to meet the Iowa diagonal line, and also to Oakland, thirty miles north of Fremont at the crossing of the Chicago, St. Paul, Minneapolis & Omaha, and eighteen miles further to Decatur, on the Missouri River, where connections are made with Chicago, Milwaukee and St. Paul, at which traffic rates for lumber and all general business are established. The local road company have met parties at Chicago who agree to take their securities and furnish funds for the construction of the road in Kansas, commencing at Salina and running southwest and northeast, as soon as the preliminary work is done and the bonds voted. The southwest branch is to be called the Kansas & Colorado Road.

BRIDGING THE MISSISSIPPI AT NEW ORLEANS.—They are talking of bridging the Mississippi at the Slaughter House, New Orleans, where the river is 2,400 ft. wide. An engineer proposes seven spans of 300 feet each, one to be a draw. The piers are to be creosoted piles, driven in clusters, and heavily capped and cased with iron. The depth of the water will be no obstacle, as the piles can be spliced. The estimated cost is $13,000,000.

THE ST. LOUIS WATER-WORKS—THE METERS.—Col. Flad on being examined said he had never at any time recommended any particular kind of meter, and produced his reports to the Board of Public Improvements to verify his statements. He said the meter recommended was a cheap kind, and cost, with all connections, $13. There could have been no ring in the matter because the outside cost of the meters would not have aggregated more than $7,000.

THE spans of the St. Paul (Minn.) Bridge were tested by the City Engineer on September 11.

THE HOOSAC TUNNEL FINANCES.—The returns made by the Hoosac Tunnel managers to the State Auditor for the month of August give a most encouraging showing for the future of the tunnel. For the first time for many years the amount paid into the treasury is really in excess of the amount drawn out, and this in spite of the fact that two-thirds of the expenditures were on construction account. The expenditures for August were $40,754, of which $25,987 were for double track. The returns for the eight months of the present fiscal year show a steady increase in earnings, and it is confidently expected that as soon as the double-tracking is completed the tunnel will net the State an average of $20,000 a month, which within a year will increase to $40,000.

THE CINCINNATI CABLE ROAD was tested on Tuesday. It is the Worcester-Haddock system. The track is 700 ft. long, and at the turns is constructed with very short curves. These were easily and successfully passed over by the car. Another advantage of the system about to be introduced in this city is the small cost. The cost of the system in use in Chicago is $125,000 per mile, while the one to be used in Cincinnati will be but $23,000 per mile. The company has decided to construct the system on Gilbert avenue, Walnut Hills, and, should that prove a success, the tracks will be extended to the corner of Fourth and Walnut.

THE St. Louis Gas, Fuel & Power Co. has applied to the Board of Public Improvements for permission to introduce its system along Franklin avenue, to Grand, Cass and other avenues and streets.

ALLIANCE (OHIO) WATER-WORKS.—The erection of these works was commenced in May last by Messrs. J. A. Cloud & Co., of New York City and are now practically completed.

The supply is taken from the Mahoning River by damming. From the dam the water is drawn off into settling basins capable of holding three millions of gallons of water. From the settling basins the water passes through a filter bed of gravel under a head of 3 ft. into a third basin, whence it is drawn into a pump well under the pumping station and thence distributed through six miles of pipe, ranging in size from 12 in. to 4 in. in diameter, on which are located 50 double hydrants, the surplus water going into a standpipe 80 ft. high and 20 ft. in diameter situated 227 ft. above the pumping station.

The various railroads centering in Alliance have contracted with the Water Co. for a daily supply of over 100,000 gallons.

HYDE PARK (ILL.) held a public meeting lately to consider the water question. A committee was appointed.

THE KENTUCKY UNION.—The survey of this road is now completed. It will have only one tunnel between Winchester and the Red River Lumber Mills, a distance of about 20 miles. This tunnel will be a little over 300 feet in length. Mr. McCoy, the chief engineer, states that bids for the construction of the road were to be taken about the first week in September, and he feels confident that the first twenty miles of it will be completed by Sept. 1, 1884.

THE Matamoras & Monterey Railroad is completed to within 13 miles of Reynosa and 41 miles from Matamoras. 400 men are at work.

THE PETTIS COUNTY (MO.) COURT-HOUSE.—The judges of the county have refused to approve the building of a county court-house to cost $100,000. The citizens will probably apply for a mandamus.

PROGRESS OF THE MEXICAN CENTRAL.—John H. Butler, with several members of his engineering corps recently employed in locating the Mexican Central Railway, arrived at Laredo direct from Zacatecas. They report the location of the railroad between El Paso and the City of Mexico as finished and only a gap of 250 miles to be completed. They don't speak encouragingly of the feeling toward Americans by Mexicans in the interior. The engineer corps of the Sunset extension into Mexico reached Saltillo Sunday, locating the route. The tracks are said to be within sixty miles of Saltillo.

EAU CLAIRE (WIS.) BRIDGES.—The last of the four new bridges has now been completed by Mr. H. E. Horton.

TERRA COTTA FOR DISTRICT OF COLUMBIA.—The contract for furnishing the terra cotta required during the fiscal year for the District of Columbia has been awarded to the Akron Sewer Pipe Agency of Ohio.

THE PROJECTED SOUTHERN PACIFIC.—The New Hampshire Senate Committee is considering a bill for incorporating this company by the provisions of which any railroad or steamboat line or lands in the United States may be purchased by the company, with the right to increase the capital stock to an unlimited extent by a vote of the parties in interest. Among the incorporators are Charles Crocker, M. F. S. Hopkins, and Isaac E. Gates attorney for Gov. Stanford, who are said to control the California system. Mr. Pierce, stated that it was proposed to consolidate the Louisiana Western, Texas & New Orleans, Galveston, Harrisburg & San Antonio, Houston & Texas, and Texas Central and other railroads, as well as steamboat lines, having an aggregate capital of upward of $50,000,000, besides owning 6,000,000 acres of land in Texas.

THE BRIDGES ON THE NORTH PACIFIC.—There are two great bridges upon the Northern Pacific: the Bismarck bridge, across the Missouri, at Bismarck, Dak., which is placed so high above the river as to require no draw, and fairly ranks among the great railroad bridges of the world; and the Ainsworth bridge, not yet completed, across the Snake River, at Ainsworth, Washington Territory, which is a low bridge with a draw. Both these bridges are built upon stone piers, with superstructures of iron and steel. The Yellowstone river is crossed three times, the upper Missouri once, and the Clarke's Fork of the Columbia three times, by Howe truss bridges. Other interest-

ing features of construction are the two long pile bridges across the arms of Lake Pend d'Oreille, each about a mile in length; and the great Marent Gulch trestle in the Coriacan Defile, which has a height of 226 feet.

NEW BRIDGE AT PHILADELPHIA.—The President of the Pennsylvania Railroad has made a proposition to erect a bridge across the Schuylkill from City avenue on the west bank to the mouth of the Wissahickon in the East Park. The cost is estimated at $100,000.

NAVIGATION OF THE MINNESOTA.—The Minnesota River is again to be navigated. a small steamer having been built in St. Paul for the purpose. The boat is 32 feet long by 10 feet wide and supplied with a 10 horse-power engine.

THE Salado Bridge on the Mexican National Road was not carried away by the floods as stated.

DISMISSAL OF EMPLOYÉS.—Nearly 100 machinists and car-builders have been dismissed from the shops of the Chicago, Milwaukee & St. Paul. In the West Milwaukee shops 1,424 hands were employed; one-tenth of these will be dismissed.

THE NEW MEXICO NARROW-GAUGE SYSTEM.—This is principally supported by New Mexico capitalists residing mostly at Albuquerque. The corporate name of the company is the "Albuquerque, Copper City & Colorado Railroad Company," but several branch roads are contemplated. The capital will be $1,000,000.

THE NEW GEORGIA STATE HOUSE.—The bill appropriating one million dollars for a new Capitol has been signed by the Governor. Bids for material, which must be either marble or granite, are open to the world.

CONTRACTS FOR GRADING, ETC.—TOLEDO, TEXAS & RIO GRANDE.—Col. Buell, who is Vice-President and Chief Engineer of this road, has closed a contract with the Keystone Construction Company for grading, bridging and laying the track. The first section of 100 miles must be completed by Jan. 1, 1884, and the rest by July 1.

DREDGING CONTRACT.—The contract for completing the dredging in the Oswego River has been let to Franklin Lee, of Buffalo. The contract calls for the excavation of 25,000 cubic yards, of which 10,000 is to be removed this fall.

DREDGING THUNDER BAY RIVER.—The contractor has finished his work of dredging out Thunder Bay River from the bridge at Alpena to the bay. The depth of water is now fourteen feet. It is the intention to still further improve the harbor by digging a channel fourteen feet deep from near the dam to the bridge.

THE NEW ORLEANS & NORTHEASTERN.—Capt. L. Whinery, engineer in charge of the north end of the road. states that there is only a gap of eighteen miles to be completed.

THE ROCKPORT (MASS.) BREAKWATER.—The surveys have been completed for the projected breakwater at Rockport by Sophus Haagenson, United States Assistant Engineer, and last week a diver walked over the course to gain a more definite idea of the character of the bottom, which is favorable for the enterprise, being firm and generally rocky. The projected breakwater will be somewhat curved in shape, one end resting on Avery's rock, near Straitsmouth, in 25 ft. of water, and the other toward Andrew's Point, a distance of about 2¼ miles, where the depth is 80 ft. This will inclose a splendid harbor of 1,600 acres. The survey shows that the work is entirely practical. The material is close at hand, and the entire expense will be about $10,000,000, of which it is hoped that Congress may be induced to appropriate $1,000,000 annually.

BIDS FOR THE BUFFALO CUSTOM-HOUSE.—Bids were opened at the Treasury Department Sept. 10 for cut stone for the superstructure of the Custom-House at Buffalo, N. Y., as follows:

Jacob Veihmeyer, Washington, $30,650.
M. A. McGowan, Washington, $32,100.
Hallowell Granite Company, New York, $44,-943.
Albert Neukon, Toledo, $48,000.
Belknap & Dumesnil, Louisville, $43,400.
P. G. Straub, Buffalo, $36,900.
W. D. Collingwood, Buffalo, $35,940.
P. R. & H. Fogelsouger, Buffalo, $36,900.
Rheinheimer Reuhl, Buffalo, $36,500.
The award has not yet been made.

THE NASHUA (N. H.) WATER-WORKS.—The Pennichuck Water Company has seventy men employed in building a new dam which will make a reservoir that will contain some 250 million gallons of water. The dam, which is to be completed about the middle of November, is to be 19 ft. 4 in. high and 52 ft. roll-way. One hundred thousand ft. of the best lumber—mostly Southern pine—and eight hundred perch of stone, to be laid in cement, are required in its construction. The average consumption of water in Nashua per day in August was eighteen thousand gallons.

THE surveys of the Chicago, Milwaukee & St. Paul extension in Dakota have been completed for a distance of 56 miles west of Aberdeen. The surveyors have completed their orders and have returned to Aberdeen for further instruction. As far as is known at present no other surveys will be run in this part of Dakota for some time. Mr. Mitchell's visit to Europe undoubtedly is to make negotiations for steel, as formerly that company have purchased large quantities in England. The survey, as made by the Chicago, Milwaukee & St. Paul Company, from Mitchell to Bismarck, is 242 miles.

OPENING OF THE NATIONAL PARK BRANCH N. P. R.—This road was completed September 1. The original surveys of the Yellowstone region were made by Mr. M. G. Grant. The road was only practically begun last November by the contractors, Winston Bros. & Clark. Mr. J. B. Clough of Minneapolis was the chief engineer, and it was necessary to make all possible haste. He was assisted in his work by T. C. Armitage, C. Isaaci, C. A. Dewar, E. G. Tabor, A. W. Dickins and C. W. Mead, and specially on tracks and bridges by B. K. Field and W. Smith. Commencing at an elevation of 4,491 ft. at Livingston, it rises to 5,174 ft. at Cinnabar, but with easy curves and grades.

THE contract for the St. Cloud, Minn., Waterworks was awarded to V. D. Simar & Co., of St. Paul, for the sum of $20,000.

THE new Cleveland, O., reservoirs now being constructed will have a combined capacity of more than 100,000,000 gallons. These reservoirs, together with some repairs at the crib and pumping-station, are to cost only $500,000.

EDISON'S ELECTRIC RAILROAD.—A large party of gentlemen connected with street railroads went to Menlo on Tuesday to inspect Edison's electric railroad. Among the visitors were Col. Paine, Assistant Engineer of the New York and Brooklyn Bridge; President Weidner, of the Market street road; President Kemble, of the Union Passenger Railroad; President Lafferty, of the Hestonville Railroad; and George Rice, Engineer of the Union Passenger Cable Railroad, all of Philadelphia; E. T. Brooks, Engineer of the Pennsylvania Railroad. A successful trip of 2¼ miles was made. It was stated that the system would be much more complete in a few months. The engineer would then take up the current from a third rail laid between the others.

ARTESIAN WELL BORING IN DENVER.—It is thought that a sufficient water supply can be obtained from the wells now boring. A gentleman engaged in the work said: "I have no doubt of it, if the drilling is conducted in the right manner. It is safe to say, however, that in some of the bores water will never be reached unless the operators change their mode of work or put in some one who knows something about the business. Some do not use the right kind of tools, others do not know how to put in their casings, and a great many show a deplorable ignorance in all things pertaining to drilling. We have an excellent opportunity of profiting by the experience of those who have bored before us. When the oil fever broke out in Pennsylvania many thousands of dollars were expended in all sorts of tools and machines, and horse powers, and spring-poles, etc. Anything in fact that would answer to drill with, was used to bore for oil. To-day there are over 60,000 wells in Pennsylvania alone, and from two hundred to four hundred are going down every month, and the only tool that an oil operator will use is the old-fashioned churn drill, worked by a thirty horse-power engine, and none but men who know how to use them are employed. These tools weigh from sixteen to twenty-two pounds. There we drill what we call a "dry hole," that is we shut off all the water in the first-sand rock and give the weight of the tools on the blow struck on the rock. The wells there are from 16 to 2,400 feet in depth. Here we do not need such heavy tools, nor an engine quite as large, and yet it is very essential to have plenty of power and good tools to drill with. The formation here is gravel and sand, and black shale and clay, and it requires great care and watchfulness in drilling through it; otherwise the well will cave in, involving a loss of time, tools and money. Hundreds of Pennsylvania men can tell you this from costly experience.

The water company of Denver have made a contract for the sinking of an artesian well at a place yet to be determined which will be supplied with an eight-inch casing. It is an experiment to demonstrate the measure of flow, whether large outlets will be more effective than outlets of a small size. Having demonstrated this to their satisfaction the company will then bore a system of wells and will run artesian water through the pipes now used for the Holly water. No water will be used from Lake Archer for drinking purposes. Twelve wells will be bored and more will follow as the increase is demanded.

KANSAS CITY CABLE ROAD.—Mr. Gilham, the superintendent, has purchased all the cables, engines, etc., for this road.

THE U. S. Electric Lighting Company has been incorporated in California with a capital of $130,-000.

A SUBTERRANEAN RIVER.—Parties boring a wel with a two foot auger at Carthage (D. T.) struck a subterranean stream of pure water in a stratum of blue clay, at a depth of 34 ft. flowing from southwest to northeast at the rate of 4 miles an hour and in a volume twice the size of the Red Stone, which flows to the southwest.

HIGH WATER IN THE RIO GRANDE.—Numerous washouts are reported on the International & Texas. The bridge over the creek near Galveston Road is gone and the road bed badly damaged. After the Monterey train on the Mexican National had crossed the bridge over the Rio Grande a large portion of the structure was washed away.

A LOW WATER BRIDGE has been designed for the use of the St. Paul and Omaha Railroad over the Missouri at Sioux City (Iowa), which seems to be cheap and practicable. The plan is for a pile and stringer bridge of the usual style across all the channel excepting a little more than 100 ft. in the deepest water. In this gap a boat is tied to nests of piles. The boat is bow up stream, and has a track across the deck. The boat is approached from either side by a swinging section of track, something like a trap now used at the transfer landings, only longer, and supported from the lower side by truss rods. This design is different from the usual pontoon in that the track runs across and not lengthwise of the boat, and further that the boat is equipped with a wheel and engines like any steamboat, to bring the boat back to place after it has been dropped down to let a steamer pass through the draw. The Chief Engineer of the road is expected in the city to look at the plan. There seems to be no reason why such a bridge, if put in with long piles, would not carry trains for nine or ten months a year.—*Exchange.*

THE National Water-Works (Kansas City) are to be greatly improved. It is said that the works will be moved higher up the Kaw River or the Missouri.

OLATHE (KANSAS) WATER-WORKS.—The council advertises for bids for constructing new waterworks.

THE ST. LOUIS, OTTAWA & TOPEKA RAILWAY.—Mr. H. P. Selden, of Kansas City, one of the projectors of the line, states that he made arrangements in the East for building this line and that it will be begun within thirty days.

THE Shenango & Allegheny Railroad was formally opened at Greenville (Pa.) on Sept. 4. The total mileage is 585.

LABOR STRIKE.—Ninety Italians employed on the New Baltimore & Philadelphia Railroad struck for an advance of 15 cents per day.

BOONVILLE (Ind.) has given contract for macadamizing the streets round the public square to Arnold & Adell, of Evansville, for $6,800.

THE Anderson, Greenfield & Shelbyville Road route was lately inspected by engineers. There is a probability that the road will be built.

GEORGIA'S capitol is to cost $1,000,000, according to the bill which has been signed by the Governor. It is to be constructed, as far as possible, of Georgia products.

WORK on the new court-house at Mt. Ayr, Iowa, has been begun. R. K. Allen, of St. Joseph, Mo., is the contractor. Price, $40,000.

THE MOHAWK, RICHFIELD SPRINGS & COOPERSTOWN R. R.—The survey on this road has been completed as far as Richfield Springs, and it is expected that work will commence this winter. This is by far the shortest route from the Mohawk Valley to Richfield Springs; it will connect at Mohawk with the N. Y., W. S. & B. R. R. W. S. Parker is Chief Engineer.

THE contract for building the St. Cloud waterworks had been given to V. D. Simar & Co., of St. Paul, Minn.

THE MINNEAPOLIS WATER-WORKS.—At the las meeting of the Board Superintendent Henion submitted a report showing the cost of 18,500 ft. of pipe is $13,000. The board is now indebted to the Chicago, Milwaukee & St. Paul Railway for $15,-000, money advanced; $6,000 will be required to pay for the pumps; pipe, $7,400; hydrants, $6,000; lead, $4,000; bills unsettled, $14,000; and other expenses, $1,000. There is now in bank to the credit of the board $41,360, and improvements will be checked unless the council makes further appropriations.

AN assistant engineer is wanted at New Haven, (Conn.) but the Board of Public Works cannot unite on any one. Some of the members wish to elect Mr. Butler.

INJECTING RAILWAY TIES.—The relative value of different methods of injecting railroad ties, to increase their durability, has been earnestly discussed, and opinions still vary widely. It is stated that on one of the German railways the pine trees injected with chloride of zinc required a renewal of 21 per cent. after a lapse of a score of years; beach trees injected with creosote required a renewal of 46 per cent. after 42 years of wear; oak ties injected with chloride of zinc required a re-

newal to the extent of about 21 per cent. after 17 years, while the same kind of ties not injected necessitated fully 49 per cent. of renewals. The conditions in all these cases were, it is stated, very favorable for reliable tests, the road-bed being also good, permitting of easy desiccation. The unrenewed ties showed on cutting that they were in perfect condition. On another road, where the oak ties were not injected, as large a proportion as 74 per cent. had to be renewed after 12 years. The same description of ties injected with chloride of zinc required only about 3¼ per cent. of renewals after seven years.—*From the San Francisco Chronicle.*

THE LYNN (MASS.) WATER SUPPLY.—The Water Board has examined the proposed site of the tubular wells. Additional wells will not be driven until on emergency requires them, It is thought that ten more would give a yield of 800,000 gallons for 24 hours pumping. The consumption now averages 2,500,000 gallons per day, and the yield from the wells now in use 500,000 gallons per day. Engineer Ball has been engaged to supervise the work of constructing the necessary connections for utilizing the Saugus River as an additional scource of supply. The work of running the lines for the proposed canals and tunnels was commenced on last Saturday afternoon.

THE bridge on the Texas & St. Louis across Rush Creek was burned Sept. 6.

THE bridge on the C., I. & St. L. & C. road near Waldron, Ind., was destroyed Sept. 5.

GOVERNMENT CONTRACTS.—The Mississippi Levee Board met at Greenville and opened bids for work. The Longwood levee in Washington County was awarded to I. F. Duffin & Bro. at 19¼ cents per yard. It is estimated at 225,000 cubic yards. The Kentucky levee in Bolivar, 70,000 cubic yards, was awarded to John B. Reid, of St. Louis, at 18 cents per yard. Considerable other work, which consists of topping, repairing and enlarging, was let at from 28 to 35 cents per cubic yard. Choctaw Bend levee was let to Clinton & Perkins, Kirk levee to Buly. Capt. I. B. Neely, who has the contract for the Alsatia, La., levee, extending over a mile, thinks he will have the contract completed by the 1st of December. Fairview, below Natchez, will also be completed by December.

CUT STONE CONTRACTS.—Bids were opened at the Treasury Department on the 10th for cut stone for the superstructure of the custom-house at Buffalo, N. Y., as follows: Jacob Veihmeyer, Washington, $30,650; M. A. McGowan, Washington, $32,100; Hallowell Granite Company, New York, $44,943; Albert Neukon. Toledo, $48,000; Belknap & Dumesnil, Louisville, $43,400; P. G. Straub, Buffalo, $36,900; W. D. Callingwood, Buffalo, $35,950; P. R. & H. Fogelsonger, Buffalo, $36,900; and Rheinheimer Reuhl, Buffalo, $36,500.

OUR NEW OFFICE-BOY.—He was a brand-new office-boy, young, pretty-faced, with golden ringlets and blue eyes. The first day he glanced over the library of the editorial room, became acquainted with everybody, knew all the printers, and went home in the evening as happy and cheery as a sunbeam. The next day he appeared, leaned out of the back window, expectorated on a bald-headed printer's pate, had four fights with another boy, borrowed 10s. from an occupant of the building, saying his mother was dead, collected his two days' pay from the cashier, hit the porter with a broomstick, pawned a coat belonging to a member of the editorial staff, wrenched knobs off the doors, pied three galleys of type, and smashed his fingers in the small press. On the third day a note was received, saying: "Mi Mother do not want I to work in such a dull place. She says I would make a good lawyer; gone fishing. Yours——"

BLASTING PAPER.—A new use for paper has been discovered in Vienna by a chemist, who prepares it so that it blasts rocks. It consists of unsized or ordinary blotting paper, coated with a hot mixture of 17 parts yellow prussiate of potash, 17 of charcoal, 35 of refined saltpetre, 70 of potassium chlorate, 10 of wheat starch and 1,500 of water. When it is dried it is cut into strips, which are rolled into cartridges.

WATER-WORKS are projected at Homestead, Pa.

HELL-HOLE SWAMP.—Mr. Renfrey, a civil engineer, has bought the famous Hell-Hole Swamp in South Carolina, paying $10,000 therefor. The swamp forms part of that purchased by the infamous land commission in the days of carpet-bag supremacy. Mr. Renfrey represents large capitalists, who propose to drain the land. If the scheme succeeds, 17,000 acres will be added to the producing power of the State, and land which is now useless and unprofitable will become a source of revenue. It is stated that to drain the water from this land will cost $100,000.

DIFFICULTIES OF RAILROAD BUILDING THROUGH THE WILDERNESS.—Very little is known by the public about the progress of the Canadian Pacific Railway, in building toward the north shore of Lake Huron. The Sault Ste. Marie Branch leaves the main line at a point called Sudbury, a little to the northwest of Lake Nipissing, and passes through an almost unbroken wilderness for a distance of about 115 miles to Algoma Mills, where for the present the branch will come to an end. The construction of these 115 miles of railway is under the management of a former resident of Brockville, and a great many difficulties have been overcome in the prosecution of the work. Grading and tracklaying have been going on all this season with much alacrity, but it has been found rather a tedious business to keep the navvies at work, owing to the prevalence of the black fly and the mosquito. These pests swarm in myriads from one end of the line to the other, and they are even worse than the mosquito in persistence and biting capacity. The immense swamps the road runs through are covered with a dense growth of trees and underbrush, and is the breeding place of these terrible marauders, and also bring forth mosquitoes in clouds. Tracklaying had to be begun from the western end, as there was no rail communication eastward, and rails and supplies were brought by water through the Georgian Bay from Owen Sound and Collingwood to Algoma Mills.

PROPOSALS FOR ARMOR PLATES.—The Navy Department invites proposals till Oct. 9 for compound armor plates. Two of 12½ in. thickness, and weighing about 21½ tons each; eight of 11½ in. thickness, weighing about 17½ tons each, and one of 11½ in. thickness, weighing about 8½ tons, with other smaller plates 9 in. in thickness. For full particulars with specifications see N. Y. *Daily Times* Aug. 29.

BRANCH RAILROAD.—ASHLAND, Penn., Aug. 28.—Work on the new branch of the railroad between this place and Pottsville, which will shorten the distance between the latter place and Shamokin over one-half, will be begun Sept. 1. The lines have already been laid and the brush along the route has been cut and cleared away. The mountains near Fountain Springs will be spanned by a bridge 300 ft. long and 200 ft. high. The work will be rapidly pushed forward.

OCEAN GROVE'S BIG WELL.—The great artesian well at Ocean Grove has been completed at last. It promises to be a great success. Eighty gallons of water flow from it every minute. The well is 420 feet deep. The water rises to a height of 28 feet above the level of the ground. The work of boring has been accomplished by the constant employment of six men, and the entire cost thus far has been about $3,500.

THE KEELY MOTOR COMPLETED.—The Directors of the Keely Motor Company held their regular monthly meeting on the 28th ult., at the offices of the corporation in Walnut street, above Ninth. President Randall, Treasurer Green, Secretary Schullermann, and Trustees Baldwin and Smith attended. The finances of the concern were said to be in a satisfactory condition. The monster engine was officially declared to be finished, and it was also declared that it would be ready for operation about this first week of September. It was announced that a final inspection of the machine by the trustees would be made to-morrow forenoon, at which all stockholders were invited to be present. Treasurer Green was exceedingly hopeful, and declared that the day of Mr. Keely's vindication was very close at hand. A Philadelphia *Times* reporter met young Mr. Boekle during the day, and he admitted specifically that the elder Boekle had not yet been introduced to the mysteries of the motor by Mr. Keely; that the inventor kept delaying matters by telling the expert that he could explain to him the curious mechanism after its completion in less than two hours. This he had not done yet, because the engine had not reached that final and highly desirable stage. Applications for passage on the first Keely train for New York have already begun to pour in from all parts of the country.

WHAT FARE TO EXPECT IN MEXICO.—There is a great deal of railroad building going on at present in Mexico, and many of our engineers will go "over the border." They need not hope to find any delicacies in the way of food or anything else. A lady thus refers to the eating problem: I haven't seen a bit of butter, a potato, an egg, a cup of tea, beefsteak, cake or any attempt at dessert for so long that I shouldn't know what to do with them. I cannot stand the Mexican grease and garlic, but live on figs and goats' milk cheese principally."

IMPROVING THE MISSISSIPPI.—The Vicksburg Convention will meet in October. Col. J. B. Miles gave the following account of his system to a correspondent: "Capt. Cowden should be there to explain and defend his outlet theory. I should be there to defend and explain my cut-off or straightening theory, and the levee men should be there to explain their theory—especially to show what they propose to do, and to explain why their levees always give away at every moderate high water at Cairo; why in 1874, with 47 feet 4 inches at Cairo, the levees gave way almost from Memphis to the gulf: why in 1882, with 47 feet 8 inches at Cairo, 4 feet 6 inches below high-water mark, the levees again gave way, and now what do they propose to do about it. I assert, and I believe almost everybody that paid attention to the condition of the river at its highest point will bear me out in the assertion, that, had the levees on the Mississippi side from Memphis to Lake Providence been high enough to hold the water, the river at Helena would have been at least three feet higher than it was. We can have no test of this until the levees are built up the opposite side of the river. I notice that the people of Louisiana are congratulating themselves that the levees are going to be built up before the next rise from near Arkansas City to the gulf on the west side of the river, including Ashton and the Morganza Bend levee. This seems to me to be a suicidal policy, so far as that portion of Louisiana lying below Red River is concerned, as the closing of the Morganza break will probably raise the water immediately below nearly three feet, and unless the levees are prepared from Red River down to hold this water it will simply break the new levee in Morgan's Bend."

IRON AND METAL MARKETS.

PHILADELPHIA, Sept. 12.

The latest developments in forge pig iron are that a scarcity of the better grades exists, and that prompt deliveries are out of the question. A number of large transactions have been quietly consummated during the past few days at $18.50 to $19, at furnace, for the most desirable brands, and hence some new buyers who have gone out to supply themselves for the next sixty to ninety days have found themselves shut out and are obliged to wait or take less desirable iron at a trifle less. There are plenty of irons in the market at $17.50, but a good iron costs $18 to make it, and the stronger companies refuse to sell at a penny less. Average selling prices are, for No. 2 Foundry, $20, delivered, and $22 for No. 1, with 50c. to $1 more for the better brands, with an improving demand all around. One thousand tons muck bars sold this week in small lots at $33.50 to $34, mill prices. An active demand exists for merchant iron, but only in small lots, at prices ranging from 2.15@2.20c., with offers of 100 ton lots at 2.10@2.05c., some of which have been accepted at country mills. The skelp mills are all busy, though not crowded. Nails are not as active as usual, and carload lots are shaded from $3; some large lots for export have gone at $2.90. Steel rails are $38 to $38.50; no large transactions. Old rails, $23 to $24; doubleheads, $26; no sales. Bridge iron is active, and mills well supplied with orders. Plate iron is strong and steady.

PITTSBURGH.

The quotations for iron in this market are: For No. 1 pig iron, four months' time, $20@$21; No. 2, $18@$20; Bessemer, nominally, $21@$21.50; gray forge, $17@$18, with the average sales at $17.50; steel rails, $38@$39 in small lots, and numerous offers which are not accepted. Old T rails are $23.50@$24, with $22.50@$23 offered. Merchant bar iron is in moderate demand for current requirement at 1.80@2c. Muck bars $33@$34, with some large transactions at $33.50. Nails, $2.75@$2.90. Numerous inquiries are in the market for old material, and Eastern agents are in the market negotiating for supplies, but there seems to be no probability of immediate business. Mills are still working less than full time; furnaces are making full time. Construction mills are all busy on orders extending 90 days ahead. Prices continue to fluctuate, because of the backwardness of the fall demand.

Bridge and car construction is being very actively prosecuted, and the demand will be continuous for this sort of work. Railroad construction in this end of the State is maintaining an active demand for all kinds of railway material. Several new short lines are projected, to be built in early spring, to develop the adjoining coal fields of this State and Virginia.

CHICAGO.

Pig iron is in fair demand, with improvement in prices during the past week. Stocks are declining, and better feeling prevails in iron circles, in consequence of the absorption by the expanding requirements.

Charcoal iron is strong and Southern irons are in good demand. Foreign irons are active in small lots. Ore has improved in demand, because of the decline. Merchant iron has shown considerable improvement, and more orders are coming to hand. Prices are 2.05@2.10c. Structural irons are active at 2.70@2.80c. for tank; $2.90c. for angles; 3.60c. for beams, and 3.80c. for channels. Galvanized iron has been in active demand, and stocks are low. Norwegian and Swedish irons are moving in the usual retail way. Russian iron is scarce. Car-load lots of nails are active at $3. Small lots, $3.10. Gas and steam pipes are 70@75 per cent. off. Tin plates are in active demand. Antimony dull. Stamped tin ware active. Ingot copper firmer. 600 tons of pig lead sold at 4.05c.